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SOS-ZEROPOL2030

D5.1 Strategic Zero Pollution Framework

Public

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EXECUTIVE SUMMARY

The EU places pollution prevention and reduction at the forefront of its environmental agenda with the EU Zero Pollution Action Plan, a key component of the European Green Deal. The plan sets a long-term vision to reduce pollution to safe levels for human health and ecosystems, within planetary boundaries by 2050. The European Ocean Pact puts further emphasis on reducing pollution in the marine environment, calling for targeted action against marine pollution and strengthening marine governance to restore the health of European regional seas. Despite the EU's comprehensive policy and regulatory framework, marine pollution remains widespread, and individual contaminant levels often exceed agreed thresholds, underscoring the urgent need for action.

To support EU efforts, the Source to Seas - Zero Pollution 2030 (SOS-ZEROPOL2030) project puts forward the SOS-ZEROPOL2030 Strategic Zero Pollution Framework to help guide action towards achieving zero pollution in European seas. The Framework focuses on four priority pollutant groups: nutrients, hazardous substances, microplastics and underwater noise. These four pollutant groups arise from widespread human activities across multiple sectors, resulting in diffuse, multi-source inputs that are difficult to attribute to single activities or pathways. Further, the Strategic Zero Pollution Framework identifies cross-cutting steppingstones to underpin proposed policy actions. Central to the Framework is the source-to-sea approach to marine pollution, which acknowledges the complexity of the four priority pollutants including their specific sources, characteristics, effects and pathways, helping to target actions towards relevant policies and actors across land, freshwater, and marine systems.

The Strategic Zero Pollution Framework is targeted towards EU decision and policy makers, industry representatives, and civil society actors to provide guidance and outline key processes and actions needed to advance towards achieving zero pollution in European regional seas. At the core of the Strategic Zero Pollution Framework are proposed objectives, targets, actions, and broad timelines for addressing pollution from nutrients, chemical contaminants, microplastics, and underwater noise. These recommendations were developed through a co-design approach that integrates the work and outputs of the SOS-ZEROPOL2030 project. The Zero Pollution Parliament held in Brussels in November 2025, and prior Regional Seas Living Labs were critical to inform the Framework, bringing together European stakeholders to explore policy options and propose recommendations for achieving zero pollution in European regional seas.

While the EU has placed (marine) pollution prevention and reduction at the forefront of its environmental agenda, further coordinated and urgent action is needed to ensure healthy and productive marine ecosystems. The Strategic Zero Pollution Framework proposes critical building blocks to progress toward the Zero Pollution vision set out under the European Green Deal and provides guidance on essential next steps to achieve this vision for the four priority pollutants (nutrients, underwater noise, microplastics, contaminants).

Table of Contents

EXECUTIVE SUMMARY **2**

1. INTRODUCTION **5**

1.1. The EU must tackle pollution in European regional seas 5

1.2. From Source to Seas – the SOS-ZEROPOL2030 Project 5

1.3. Addressing pollution at the centre of the EU's policy vision 5

2. A STRATEGIC ZERO POLLUTION FRAMEWORK **7**

3. NUTRIENTS **10**

3.1. Pollutant profile 10

3.2. Zero Pollution Vision 2030 10

3.3. Key challenges 11

3.4. SOS-ZEROPOL2030 objectives, targets and actions 11

4. HAZARDOUS SUBSTANCES **14**

4.1. Pollutant profile 14

4.2. Zero Pollution Vision 2030 Target 15

4.3. Key challenges 16

4.4. SOS-ZEROPOL2030 objectives, targets, and actions 16

5. MICROPLASTICS **19**

5.1. Pollutant profile 19

5.2. Zero Pollution Vision 2030 Target 20

5.3. Key challenges 20

5.4. SOS-ZEROPOL2030 objectives, targets, and actions 21

6. UNDERWATER NOISE **24**

6.1. Pollutant profile 24

6.2. Zero Pollution Vision 2030 Target 24

6.3. Key challenges 26

6.4. SOS-ZEROPOL2030 objectives, targets and actions 26

7. UNDERPINNING ACTIONS ACROSS THE FOUR POLLUTANTS **29**

7.1. Stepping stones to support policy action 29

7.2. SOS-ZEROPOL2030 objectives, targets and actions 30

8. SUMMARY AND OUTLOOK **32**

REFERENCES **33**

ANNEX **40**

Table 1: Policy landscape 40

Table 2: Nutrients objectives, targets and actions 44

Table 3: Hazardous substances objectives, targets and actions 50

Table 4: Microplastics objectives, targets and actions 55

Table 5: Underwater noise objectives, targets and actions 60

Table 6: Actions across the four pollutants 65

List of abbreviations

BAT	Best Available Techniques
CAP	Common Agricultural Policy
CLP	Regulation on the Classification, Labelling and Packaging of Substances and Mixtures
CMR	Carcinogenic, mutagenic and reprotoxic (substances)
EC	European Commission
ECHA	European Chemicals Agency
EEA	European Environment Agency
EIA	Environmental Impact Assessment
EMSA	European Maritime Safety Agency
EU	European Union
GES	Good Environmental Status
GHG	Greenhouse gas (emissions)
IED	Industrial Emissions Directive
INMAP	Integrated Nutrient Management Plan
LOBE	Level of Onset of Biologically Adverse Effects
MPs	Microplastics
MSFD	Marine Strategy Framework Directive
MSP	Marine Spatial Planning
NEC	National emission reduction commitments directive
NH_3	Ammonia
NO2	Nitrogen dioxide
NOx	Nitrogen oxide
P	Phosphorus
PBTs	Persistent, bioaccumulative and toxic (substances)
PCBs	Polychlorinated biphenyls
PDCA	Plan-do-check-act (cycle)
PFAS	Per- and polyfluoralkyl substances
PoM	Programme of measures
POPs	Persistent organic pollutants
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals (Regulation)
R&D	Research and development
SOW	Spatial Observation Window
SSbD	Safe and sustainable by design
SVHC	Substances of very high concern
TOW	Temporal Observation Window
URN	Underwater radiated noise
UWWTD	Urban Wastewater Treatment Directive
vPvB	Very persistent and very bioaccumulative (substances)
WFD	Water Framework Directive
WWTP	Wastewater treatment plant
ZPAP	Zero Pollution Action Plan

1. INTRODUCTION

1.1. The EU must tackle pollution in European regional seas

European regional seas, including the Baltic Sea, the Black Sea, the Mediterranean Sea and the North-East Atlantic Ocean, are facing mounting pressures from human activities including marine pollution that originates from both land and sea. Marine pollution is characterised by a high number, diversity and complexity of pollutants (Dahms, 2014). In European Regional Seas, marine pollution includes both legacy pollutants (i.e., a persistent pollutant that remains in the environment from past activities) and emerging pollutants (i.e., unregulated and not commonly monitored pollutants). Examples of marine pollutants include nutrients, widely used chemicals, plastic (including microplastics), underwater noise, light, heat (thermal pollution), as well as non-indigenous/invasive species (biological pollution).

An assessment of contaminants in European seas revealed that 16% of the 1,541 assessment units studied are in a healthy condition—classified as 'non-problem areas' (European Environment Agency 2019a).[1] At the regional sea level, 7% of the assessment units in the Baltic Sea, 19% in the Black Sea, 7% in the Mediterranean Sea, and 21% in the North-East Atlantic Ocean are 'non-problem areas' (ibid.). However, an analysis of the state of the marine environment, based on the 11 qualitative descriptors of Good Environmental Status (GES) under the Marine Strategy Framework Directive (MSFD, 2008/56/EC) — including chemical contaminants, marine litter, and underwater noise —highlights that EU marine waters and ecosystems generally do not yet achieve 'good environmental status' (European Commission 2025a). Despite a comprehensive policy and regulatory framework, marine pollution remains widespread, and individual contaminant levels often exceed agreed thresholds, underscoring the urgent need for action.

1.2. From Source to Seas – the SOS-ZEROPOL2030 Project

In this context, the Source to Seas - Zero Pollution 2030 (SOS-ZEROPOL2030) project proposes a holistic framework – **the Strategic Zero Pollution Framework** – to help guide the EU towards achieving zero pollution in European seas. The Strategic Zero Pollution Framework focuses on four priority pollutant groups: nutrient inputs, hazardous substances, microplastics and underwater noise. The Framework is targeted to EU decision and policy makers, industry representatives and civil society actors aiming to provide guidance and outline the key processes and actions needed to advance towards achieving zero pollution in European Seas.

1.3. Addressing pollution at the centre of the EU's policy vision

Recognising the urgency of pollution in European Seas, the EU has placed pollution prevention and reduction at the forefront of its environmental agenda. Central to these efforts is the EU Zero Pollution Action Plan (European Commission 2021), a key component of the European Green Deal (European Commission 2019) that sets a long-term vision to achieve a toxic-free environment by 2050. The plan outlines a comprehensive framework for reducing pollution across all environmental compartments — air, water, and soil — and calls for coordinated action to curb pollution at its source.

[1] For an overview on the definition of assessment units see Annex 1 (European Environment Agency 2019b).

The zero-pollution vision for 2050 is translated into key targets for 2030 to speed up reducing pollution at source. These targets include:

- improving air quality to reduce the number of premature deaths caused by air pollution by 55%;
- improving water quality by reducing waste, plastic litter at sea (by 50%) and microplastics released into the environment (by 30%);
- improving soil quality by reducing nutrient losses and chemical pesticide use by 50%;
- reducing the number of EU ecosystems where air pollution threatens biodiversity by 25%;
- reducing the share of people chronically disturbed by transport noise by 30%; and
- reducing waste generation by a significant amount and reducing residual municipal waste by 50%.

A range of policies (see Figure 1) build the foundation for achieving the EU's zero pollution vision. The Circular Economy Action Plan (European Commission 2020a) emphasises the need for a new economic model that distances itself from a linear economy and shifts towards a more sustainable and circular economy following the principles of "reuse, share, repair and recycle". The Plastics Strategy (European Commission 2018) aims to "transform the way plastic products are designed, produced, used and recycled in the EU". The Chemical Strategy for Sustainability (European Commission 2020b) focuses on improved protection of EU citizens and the environment, while driving innovation towards safe and sustainable chemicals.

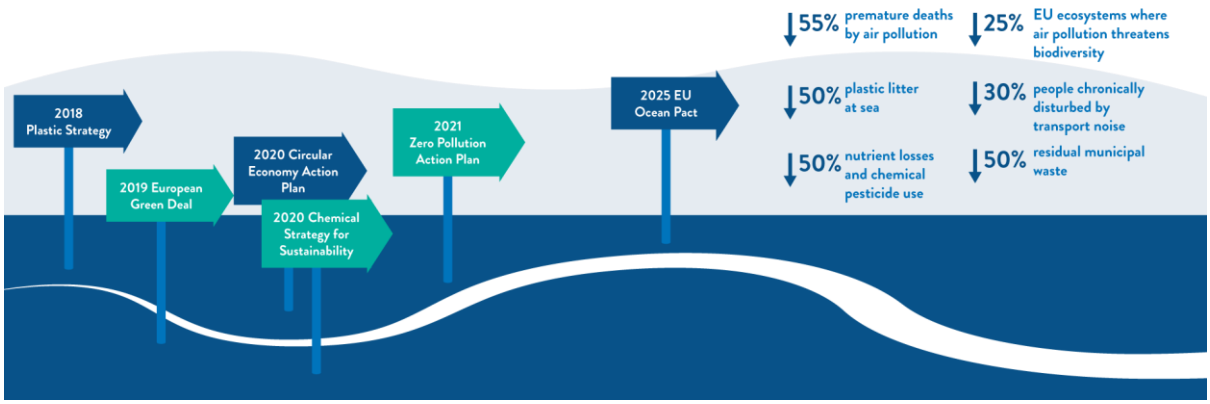


Figure 1 Main EU policy developments towards zero pollution

In the context of marine pollution, the Zero Pollution Action Plan (ZPAP) strengthens, reinforces and complements existing legislation, including the MSFD (European Commission 2008), which serves as the primary legal instrument to achieve Good Environmental Status in EU marine waters. The Water Framework Directive (WFD, 2000/60/EC) (European Commission 2000), focusing on inland and coastal waters, and the Urban Wastewater Treatment Directive (UWWTD, (EU) 2024/3019) (European Commission 2014), targeting discharges from urban areas, also play crucial roles in reducing land-based sources of marine pollution. In addition, the Industrial Emissions Directive (IED, 2010/75/EU) (European Commission 2010), the Registration, Evaluation, Authorisation and Restriction of Chemicals Regulation ((EC) 1907/2006) (European Commission 2006), as well as the Biocidal Products

Regulation ((EU) 528/2012) (European Parliament and Council 2012) and the Plant Protection Products Regulation ((EC) 1107/2009) (European Parliament and Council 2009) contribute to the control of hazardous substances entering the marine environment.

Reinforcing these initiatives, the European Ocean Pact (European Commission 2025b), officially adopted in 2025, places further emphasis on reducing pollution in the marine environment. It calls for targeted action against nutrient, plastic, chemical, and noise pollution and strengthens marine governance, monitoring, and international cooperation, which are key to restoring the health of Europe's seas and achieving good environmental status. One key principle mentioned in the Ocean Pact is the source-to-sea approach to tackling pollution that is intended to act as a guide for the proposed actions and considering land-based sources of marine pollution (European Commission 2025c).

At the regional level, Regional Seas Conventions, namely the Barcelona Convention, Bucharest Convention, Helsinki Convention, and Oslo-Paris Convention play a critical role in coordinating EU and non-EU Contracting Parties in the implementation of joint policy actions and strategies aimed at reducing marine pollution. Actions taken by the EU and the Regional Sea Conventions are transposed into national policies and strategies to address marine pollution at the country level. As a result, a wide range of policies exist to support the prevention, reduction, and management of marine pollution in European Regional Seas. These policies include legal obligations, targets, incentives, and guidance encouraging collective action that is directed at governments, implementing agencies, industry, as well as civil society actors and society at large.

2. A STRATEGIC ZERO POLLUTION FRAMEWORK

The Strategic Zero Pollution Framework introduced here outlines objectives, targets, actions, and broad timelines to address marine pollution from nutrients, chemical contaminants, microplastics, and underwater noise, in an effort to guide the EU toward achieving zero pollution in European seas by 2030 and beyond. The framework integrates and builds on the following elements:

- **Pollutant profile**: Introduction to the individual pollutants, including source-to-sea considerations.
- **Zero Pollution Vision 2030 Target**: Overview of the related zero pollution vision 2030 target as defined in the Zero Pollution Action Plan.
- **Key challenges**: Summary of the main challenges and gaps in knowledge, policy and governance.
- **SOS-ZEROPOL2030 objectives, targets and actions**: Objectives and targets defined by SOS-ZEROPOL2030 that will help reach the related Zero Pollution Vision 2030 Target. These are accompanied by concrete actions that outline how the objectives and targets can be achieved.
- **Stakeholders**: Identification of the key stakeholders necessary for effective implementation of actions and measures.

The Strategic Zero Pollution Framework is developed through a co-design approach that integrates the work and outputs of the SOS-ZEROPOL2030 project (see Figure 2). The Framework draws upon key concepts for marine pollution governance and management. Multi-stakeholder engagement is at the core of the approach, which is informed by, and informs: data, information, and evidence and evidence analysis; targets and actions for marine pollution reduction, prevention, mitigation and monitoring; and marine pollution management objectives.

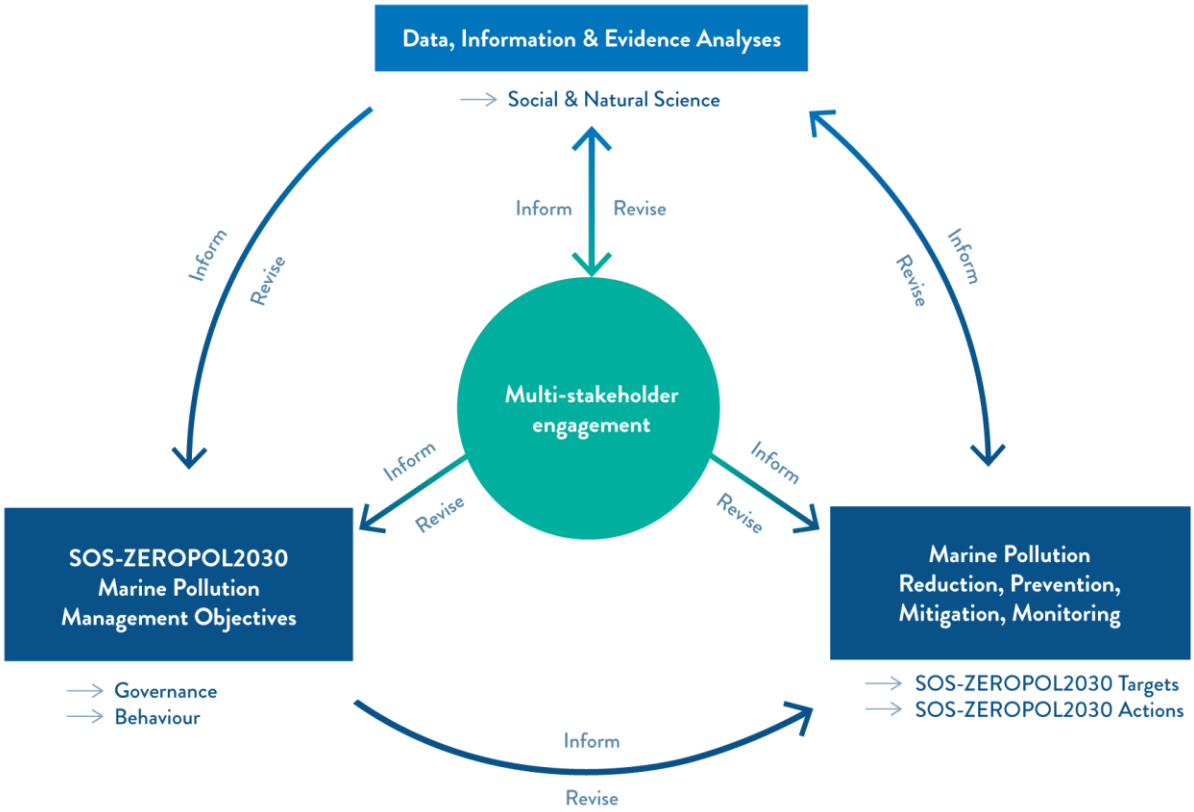


Figure 2 The Co-Design Approach of the SOS-ZEROPOL2030 Project

The objectives, targets, and actions proposed in the Framework have been co-designed with project partners and stakeholders to reflect and respond to ongoing EU policy developments and challenges relevant to the specific pollutants and the vision of the European Green Deal and its ZPAP. In addition, the Zero Pollution Parliament (Kopke et al. 2026), held in Brussels in November 2025 and building on prior Regional Seas Living Labs (van Hulst et al. 2024, 2025), brought together 33 stakeholders from 16 European countries to engage participants in structured, scenario-based discussions to explore pathways and propose recommendations for achieving zero pollution in European seas. The stakeholders included research institutes, universities, NGOs, industry and the private sector, as well as relevant EU, national, and international bodies. The Zero Pollution Parliament encouraged open exchange between these stakeholder groups, allowing participants to articulate their preferred future pathways and discuss trade-offs, synergies, and shared priorities, and ultimately translating discussions into concrete EU-level recommendations, targets, and actions to support the implementation of zero-pollution objectives for European seas. Central to the Framework is the application of a source-to-sea approach to marine pollution, which helps to identify and understand

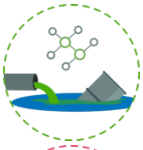
pollutant pathways and therefore the interlinkages between policies and actors across land, freshwater, and marine systems (see Box 1).

Box 1: The source-to-sea approach

Source-to-sea refers to a comprehensive management strategy that takes a holistic view of the sources of, and solutions to, the problem of pollution. A source-to-sea approach is essential to address the intricate web of interconnected ecosystems comprising marine, land, and freshwater resources. Recognising the inherent interlinkages and dependencies among these ecosystems, the source-to-sea approach promotes coordinated actions that include upstream and downstream considerations, ensuring that interventions in one part of the system do not inadvertently cause harm elsewhere (Granit et al. 2017; Mathews and Stretz 2019; Del Savio et al. 2026). Implementing the source-to-sea approach involves several key components, including integrated governance across different sectors and administrative levels, robust data and monitoring across the source-to-sea continuum, aligned policies to ensure consistency and effectiveness of management, active community engagement for solutions that are context-specific and equitable, and adaptive management that can be adjusted based on monitoring data and changing environmental conditions (Granit et al. 2017; Mathews and Stretz 2019; Del Savio et al. 2026).

The **Strategic Zero Pollution Framework** focuses on four priority pollutant groups.

Nutrient inputs, with particular attention to sources and pathways linked to agricultural activities.



Hazardous substances, especially those considered 'most harmful substances'.

Plastic litter, with a specific focus on microplastics present in the marine environment.

Underwater noise, as an emerging form of pollution impacting marine ecosystems**.**

These four pollutant groups share common characteristics. For all, pressures arise from widespread human activities across multiple sectors, resulting in diffuse, multi-source inputs that are difficult to attribute to single activities or pathways. They are also characterised by complex transport and dispersal processes (via water, air, food webs, or sound propagation), meaning that impacts are often transboundary and extend well beyond their point of origin. This spatial and temporal variability, combined with data gaps, limited harmonised

monitoring, and incomplete understanding of ecological effects (particularly for mixtures, emerging substances, microplastics, and biological thresholds for underwater noise), makes quantification, comparison, and regulation challenging. As a result, these pollutants require coordinated, cross-sectoral and ecosystem-based management approaches, including at the regional sea-basin scale, in line with the EU Zero Pollution ambition and MSFD objectives to address cumulative impacts on marine ecosystems.

3. NUTRIENTS

3.1. Pollutant profile

Nutrient pollution is defined as the presence of excessive nutrients, including nitrogen and phosphorus compounds, in aquatic systems. The impacts of nutrient pollution on marine ecosystems are diverse and often interrelated, including eutrophication, hypoxia (reduced oxygen levels leading to the formation of dead zones), and the proliferation of harmful algal blooms (Billen and Garnier 2007; Diaz and Rosenberg 2008; Grizzetti et al. 2021a; Devlin and Brodie 2023). These processes can disrupt ecosystem structure and functioning, degrade habitats, reduce biodiversity, and pose significant risks to human health and wildlife. Eutrophication poses a threat to the provision of essential ecosystem services, including the supply of drinking water, recreation, and habitat provision for fish and wildlife (Culhane et al. 2019). Direct effects on human health include respiratory illness due to nitrogen dioxide (NO2) (de Vries 2021). Harmful algal blooms can produce toxins that threaten human and animal health, e.g. causing fish mortalities (Karlson et al. 2021) and hypoxic bottom waters can cause dead zones, such as witnessed in the Baltic Sea (Diaz and Rosenberg 2008).

Excess nutrients enter the marine environment via various anthropogenic activities, including agricultural and aquacultural discharges, urban runoff, municipal and industrial wastewater discharge, and atmospheric deposition (Devriese et al. 2025; Grizzetti et al. 2021b; European Commission Joint Research Centre 2023). The emission of nutrients includes those from mineral fertilisers, manure application, nitrogen crops, and soil fixation (European Commission Joint Research Centre 2023). Additionally, inputs from scattered dwellings, (i.e., isolated houses not connected to sewerage systems) contribute to nutrient emissions (ibid.). Sea-based sources comprise aquaculture, dumping of dredged material and discharges from ships. Atmospheric deposition of nitrogen, primarily from fossil fuel combustion (NO_x) and agricultural ammonia emissions (NH_3), contributes significantly to nutrient loading in aquatic ecosystems (European Environment Agency and European Commission Joint Research Centre 2025).

3.2. Zero Pollution Vision 2030

The ZPAP sets the Zero Pollution Vision 2030 target to reduce nutrient losses by 50%; and the EU ecosystems where air pollution (including atmospheric nitrogen deposition) threatens biodiversity by 25%. This is to be achieved through sustainable nutrient management, nutrient load reductions and the application of balanced fertilisation. Several policies under the EU Green Deal address the targets including the EU Biodiversity Strategy to 2030 and the

Farm to Fork Strategy. EU policies such as the Nitrates Directive (91/676/EEC), UWWTD, IED, WFD and MFSD aim to address nutrient pollution and the reduction of nutrient emissions across various sectors and compartments (European Environment Agency and European Commission Joint Research Centre 2025). The Integrated Nutrient Management Action Plan (INMAP) will serve as a strategic framework to support and enhance the coherence of existing EU legislation on nutrient pollution, such as the Nitrates Directive and WFD. An overview of legislation that targets nutrients from various sources is provided in Table 1 (see Annex Table 1: Policy landscape).

3.3. Key challenges

Based on the research conducted within the SOS-ZEROPOL2030 project, a number of key challenges related to excess nutrients have been identified (Devriese et al. 2023, 2025):

- The ZPAP nutrient loss targets, reducing losses by 50% and cutting by 25% the area of EU ecosystems threatened by air pollution (including nitrogen deposition), are deemed unfeasible as they are not currently assessable in terms of attainability. This reflects the complexity of nutrient cycles, challenges in quantifying diffuse emissions, and the lack of a single comprehensive indicator.
- The involvement of numerous sectors and environmental compartments makes effective assessment and coordinated management extremely difficult.
- The EU aims to reduce the number of ecosystems exceeding critical nitrogen deposition loads by 25% by 2030 (vs. 2005). Ammonia (NH_3) and nitrogen oxide (NO_x) emissions remain high, particularly from agriculture and transport/industry, and where current mitigation measures are insufficient. Current projections indicate only a 19% reduction, with a baseline 23% reduction, which is close but still short of the 25% target.

3.4. SOS-ZEROPOL2030 objectives, targets and actions

Following the Zero Pollution Vision 2030 Targets, the following objectives, targets and actions to address nutrient pollution and achieve the Zero Pollution Ambition by 2030 have been identified:

Objective 1: Improve nutrient management in agriculture to reduce losses at source

- Target 1.1: By 2030, each Member State has reduced nutrient (nitrogen, e.g., NH_3 and NO_3^-) losses by at least 50%, prioritising high-risk areas with intensive farming and high runoff potential (Farm to Fork Strategy, ZPAP).
  - **Action 1.1.1**: Implement precision fertilisation, adjust timing and method of fertiliser and manure application, adopt nutrient-efficient crops, and optimise slurry storage.
- Target 1.2: By 2030, each Member State has reduced phosphorus losses to water bodies by at least 30% (Nitrates Directive, CAP Strategic Plans).
  - **Action 1.2.1**: Mandate phosphorus-based soil testing, implement buffer strips, cover crops, and soil conservation measures along waterways.
- Target 1.3: By 2030, all farms minimise NH_3 emissions from livestock and manure management by 25% (NEC Directive, Farm to Fork Strategy).
  - **Action 1.3.1:** Introduce low-emission manure spreading, improve barn ventilation, manage manure storage.

- Target 1.4: By 2027, all farms in Nitrate Vulnerable Zones fully comply with maximum nitrogen application limits (Nitrates Directive).
  - **Action 1.4.1**: Monitor soil and water nitrate levels, enforce limits, provide advisory support.

Objective 2: Reduce atmospheric nutrient pollution and ecosystem deposition

- Target 2.1: By 2030, Member States reduce ammonia (NH_3) and nitrogen oxides (NOx) deposition in sensitive ecosystems by 25% (NEC Directive).
  - **Action 2.1.1:** Implement sectoral emission reduction programmes, cleaner technologies, and enforce national ceilings.
- Target 2.2: By 2030, all industrial installations apply Best Available Techniques (BAT) to limit NO_x emissions (IED).
  - **Action 2.2.1**: Upgrade combustion plants, adopt low-NO_x technologies, and improve emissions monitoring.

Objective 3: Protect and restore ecosystems from nutrient-driven degradation

- Target 3.1: By 2030, nutrient runoff into freshwater and coastal systems has been reduced (WFD).
  - **Action 3.1.1**: Buffer strips, cover crops, constructed wetlands, catchment-level monitoring.
- Target 3.2: By 2030, harmful algal blooms and hypoxic zones in high-risk water bodies have been minimised (EU Water Policy, national programmes).
  - **Action 3.2.1:** Targeted mitigation in high-risk catchments, monitor water quality, adaptive management.
- Target 3.3: By 2040, ecological integrity and ecosystem services in freshwater and coastal habitats are maintained (EU Biodiversity Strategy, Habitats Directive).
  - **Action 3.3.1:** Restore riparian zones, maintain natural water flows, and rehabilitate impacted habitats.
- Target 3.4: By 2030, at least 30% of EU land and sea areas are protected and restored, including 25,000 km of rivers (EU Biodiversity Strategy).
  - **Action 3.4.1**: Restore habitats, enforce protected area regulations, enhance resilience.

Objective 4: Close the nutrient loop through circular economy and innovation

- Target 4.1: By 2030, recycling of organic waste and by-products has been increased (Farm to Fork Strategy, Circular Economy Action Plan).
  - **Action 4.1.1:** Develop composting infrastructure, implement nutrient recovery technologies, establish regional reuse schemes.
- Target 4.2: By 2030, integrated nutrient and resource management plans have been implemented at landscape or regional scale (CAP Strategic Plans, national initiatives).
  - **Action 4.2.1:** Support knowledge transfer, demonstration sites, cross-sector coordination.
- Target 4.3: By 2030, innovative technologies and practices to optimise nutrient flows and enhance system resilience are being promoted (Horizon Europe, EU Innovation Programmes).
  - **Action 4.3.1:** Precision mapping, digital tracking of nutrient flows, adoption of circular economy solutions.

Objective 5: Reform the Common Agricultural Policy to reward nutrient performance

- Target 5.1: By 2030, at least 60% of CAP direct payments are conditional on verifiable environmental performance, including nutrient management requirements (CAP post-2027, Zero Pollution Parliament).
  - **Action 5.1.1:** Make subsidies conditional, linking direct payments to lower impact farming practices e.g., precision fertilisation: mandating soil testing and calibrated application of fertilisers to match crop needs; cover cropping: paying farmers to plant cover crops in the off-season to capture residual nitrogen; and maintenance of buffer strips: providing subsidies for establishing and maintaining vegetated strips along watercourses.
  - **Action 5.1.2:** Develop an "eco-scheme" by legislating that 30% of the CAP budget is reserved exclusively for agri-environment-climate commitments, preventing its reallocation to basic income support.
  - **Action 5.1.3:** Limit large payments by introducing a progressive capping mechanism for direct payments to very large farms, reallocating those funds to support smaller farms and those undergoing complex transitions to agroecology.
- Target 5.2 By 2035, the EU should achieve a 30% reduction in surplus nitrogen across agricultural soils in Nitrate Vulnerable Zones compared to a 2025 baseline, directly attributable to CAP incentives (Zero Pollution Parliament).
  - **Action 5.2.1:** Integration with Other Policies: Ensure CAP strategic plans are legally required to demonstrate alignment with WFD and MSFD targets.

Objective 6: Empower consumers and de-risk the transition for farmers

- Target 6.1: By 2030, establish a mandatory EU-wide nutrient footprint labelling system for major food products that reflects the nutrient footprint (Zero Pollution Parliament).
  - **Action 6.1.1:** By 2028, develop a standardised lifecycle assessment methodology to calculate a "fertiliser input per kilogram of product" score (A-to-G rating).
  - **Action 6.1.2**: By 2030, launch a mandatory EU-wide "Nutrient Efficiency Label" for all major staple crops (e.g., cereals, potatoes, vegetables) sold in supermarkets by assigning an A-to-G rating on product packaging.
- Target 6.2 By 2030, establish a publicly funded "Transition Advisory Service" in every EU Member State, aiming to engage at least 25% of all agricultural holdings in nutrient reduction planning by 2035 (Zero Pollution Parliament).
  - **Action 6.2.1:** Establish national transition networks by funding a network of regional advisors, employed by the government but working closely with farming unions, to provide free, one-on-one consultancy on agroecological transition.
  - **Action 6.2.2:** Support business case development by creating and disseminating region-specific, crop-specific business models that clearly outline the costs, benefits, and market opportunities for low-nutrient farming systems.
  - **Action 6.2.3:** Offer financial support through temporary, targeted income support or low-interest loans to farmers during the transition period, which often involves a temporary dip in yield or profitability.

A summary of the above is presented in Table 2 in the Annex.

4. HAZARDOUS SUBSTANCES

4.1. Pollutant profile

Hazardous substances (e.g., PFAS) can exhibit various properties that individually or in combination can have negative impacts on the environment and human health, including persistence, bioaccumulation, ecotoxicity, carcinogenicity, mutagenicity, reproductive toxicity, and endocrine disruption (Gomez Cortes et al. 2025). The EU regulations REACH and the revised Regulation on the Classification, Labelling and Packaging of Substances and Mixtures (CLP, (EU) 2024/2865) categorise hazardous substances into hazard classes. The European Chemicals Agency (ECHA) has listed 247 SVHC, as defined under REACH and in accordance with the CLP (ECHA 2025). Substances bearing hazard classifications such as carcinogenic, mutagenic and reprotoxic (CMR), persistent, bioaccumulative, and toxic (PBT), or very persistent and very bioaccumulative (vPvB), or those with an equivalent level of concern are classified as SVHC (European Commission Joint Research Centre 2017).

ECHA continues to add new substances to the list following updated hazard classifications. The presence of hazardous substances, including POPs, certain metals, phenols and phthalates as well as active ingredients in pesticides in EU marine waters is not well documented. There are large data gaps when it comes to these substances in the marine environment. One aspect is the lack of comprehensive monitoring for the listed hazardous substances, another aspect the limited availability of standards for sampling, measuring, and analysing the presence of, for example, most PFAS. Moreover, the large number of different PFAS, combined with high persistence in marine environments, high mobility and (eco)toxicological profile, means that it is highly challenging to set up effective monitoring for these substances. Monitoring the presence of hazardous substances in marine organisms in European seas between 2010 and 2019 revealed that benzo[a]pyrene, lindane (γ-HCH) and polychlorinated biphenyls (PCBs) levels in particular exceeded the established safe limit values in some areas (European Environment Agency 2024).

Chemical contaminants, including heavy metals, air pollutants and highly hazardous pesticides, have been shown to have severe human health effects, such as chronic diseases, neurological disorders, immunotoxic effects, genetic damage and endocrine system disruption (European Environment Agency and European Commission Joint Research Centre 2025; European Environment Agency 2022).

Human exposure to these contaminants and complex chemical mixtures occurs due to contamination of drinking water and food, inhalation of polluted air and dust, occupational activities and the use of everyday consumer items (European Environment Agency 2022). Chemicals can exert a direct influence on human health and the environment at all stages of their life cycle, as chemical emissions can occur at each life cycle stage, including chemical manufacturing, use in production, product use and waste treatment (European Environment Agency 2024). Furthermore, indirect impacts of chemicals occur due to energy consumption, greenhouse gas emissions, and waste production.

Primary emission sources include wastewater from industries, households, and public institutions like hospitals, universities, etc. (Pastorino and Ginebreda 2021). Although wastewater treatment plants (WWTPs) may remove certain hazardous substances from waste effluents, they may also induce reactions that transform specific contaminants into other, potentially more hazardous chemicals.

Contaminants from agriculture, introduced by the use of pesticides, seed coatings, veterinary drugs, reuse of sewage sludge, spillage of lubricants and leachates from plastics, may directly enter into groundwater or surface water. The same applies to contaminants released from products used in external or direct contact with the natural environment (e.g., plastics, paints, coatings, chemicals used in mining and the extraction of natural gas and oil, etc.).

Contaminants emitted directly into surface water combine with effluents from WWTPs and runoff, and flow through canals and rivers into the marine environment. Chemicals with relatively high volatility have the potential to evaporate from land-based sources (which may be any compartment) and enter the marine environment through precipitation.

In addition to atmospheric deposition and waterborne transport, hazardous substances can be released into the marine environment through sea-based sources, such as shipping, harbour and port activities, offshore oil exploration, aquaculture, ammunition, offshore oil exploration, aquaculture, ammunition, and (seabed) mining (European Environment Agency 2011; Tornero and Hanke 2016).

4.2. Zero Pollution Vision 2030 Target

The EU has a comprehensive framework comprising of approximately 40 legislative instruments to regulate chemicals (European Commission, 2020). The ZPAP sets the Zero Pollution Vision 2030 Target as a 50% reduction in the overall use and risk of chemical pesticides and a 50% reduction in the use of more hazardous pesticides by 2030.[2]

The Chemicals Strategy for Sustainability provides guidance to achieving the zero-pollution ambition for producing and using chemicals that avoid causing harm to the planet and future generations by 2030. Several other policies under the EU Green Deal contribute to achieving these targets, including the Circular Economy Action Plan, the Farm to Fork Strategy, the Biodiversity Strategy, and the Chemicals Strategy for Sustainability. These overarching policies are supported by more specific legislation that targets chemical pollution from various sources. An overview is provided in Table 1 (see Annex Table 1: Policy landscape).

[2] These targets will be measured against a 2015-2017 baseline and are based on: the quantities of active substances contained in the pesticides which are placed on the market (sold), and therefore used, in each Member State, and the hazard properties of these active substance; and using data on the quantities of more hazardous active substances, the so called 'candidates for substitution', contained in the pesticides which are placed on the market (sold), and therefore used, in each Member State.

4.3. Key challenges

Based on the research conducted within the SOS-ZEROPOL2030 project, several key challenges related to contaminants have been identified (Devriese et al. 2023, 2025):

- Emerging contaminants: voluntary and inconsistent monitoring frameworks hinder comprehensive assessment across regions and limit the development of effective mitigation strategies.
- Significant gaps remain in understanding the environmental behaviour and impacts of emerging contaminants, making it difficult to establish causal links between their concentrations and observed environmental harm.
- Limited understanding of degradation over time; metabolic pathways in organisms and the degradation of a chemical in the environment can be very different and are often complex in terms of reaction kinetics, schemes, etc.
- Reliable identification and quantification of the substances in consumer products, as well as in environmental matrices is challenging and requires significant resources.
- Limited understanding of the effects of controlled waste handling processes for many End-of-Life products and the hazardous substances they contain.
- Persistent pollutants remain in the environment for long periods, with effects that are difficult to reverse even after emissions have stopped.
- Limited transparency throughout product chains in terms of chemicals used to produce a material or as a part of a formulation, as datasheets are not required to report on low quantities of chemicals and not at all for polymers.

4.4. SOS-ZEROPOL2030 objectives, targets, and actions

Following the Zero Pollution Vision 2030 Target, the following objectives, targets and actions to address hazardous substance pollution and achieve the Zero Pollution Ambition by 2030 have been identified:

Objective 1: Harmonise monitoring of most harmful substances

- Target 1.1: By 2035 establish a working method that incorporates sampling and analysis methodologies, as well as data exchange mechanisms between river and marine environmental monitoring programmes (MSFD, WFD).
  - **Action 1.1.1**: Establish regular meetings between riverine and marine monitoring programmes to exchange knowledge and data on monitoring practices.
  - **Action 1.1.2**: Establish a consultation platform for authorities related to riverine and marine monitoring programmes.
  - **Action 1.1.3**: Harmonise reporting standards so that datasets from riverine and marine monitoring programmes are interoperable.
- Target 1.2: Create a coordinated approach (e.g. digital tools) to ensure data on hazardous substances is Findable, Accessible, Interoperable, and Reusable (FAIR), starting in data rich areas (MSFD, Drinking Water Directive, Regulation (EU) 2025/2455).
  - **Action 1.2.1**: Develop a platform (e.g. data repository, digital tools) with data from curated datasets, based on harmonised sampling and analysis methodologies to improve the quality of predictions (such as hotspot areas, concentration differences between environmental matrices, and concentration distributions over time).

- **Action 1.2.2**: Create models to predict where the most effective monitoring should be conducted and explore the use of big data approaches.

- Target 1.3: Support the performance of robust risk assessments of chemicals/substances by identifying and filling data gaps (Zero Pollution Parliament).
  - **Action 1.3.1**: Find out what data is most often missing to perform a robust risk assessment for chemicals/substances and ensure that monitoring programs will provide that data, for example following the plan-do-check-act (PDCA) cycle.

Objective 2: Improve transparency throughout the value chain

- Target 2.1: Facilitate implementation of Safe and Sustainable-by-Design (SSbD) principles by ensuring that confidential information that is required for execution of SSbD processes can be shared throughout the value chain (REACH, Methodological guidance to SSbD, European Chemicals Industry Action Plan).
  - **Action 2.1.1:** Building onto the existing REACH-IT portal, the EU creates a secure space where confidential data can be shared and accessed by those companies that develop specific chemicals/substances/materials that are responsible for emissions throughout their value chain.
  - **Action 2.1.2:** Set clear guidelines on how companies should use the tools in the SSbD framework but allow for adapting the guidelines based on the learning and experience from early adopters; start small and use an iterative approach.
  - **Action 2.1.3:** Use public procurement processes to stimulate SSbD implementation, especially in tender processes.
  - **Action 2.1.4:** Create a level playing field among companies within the EU to ensure that companies that invest significantly in developing safe and sustainable products will be able to capitalise on these efforts. Companies from outside the EU must also meet the same requirements for products imported and sold within the EU.

Objective 3: Drive transformative shift towards a sustainable, circular, and climate-neutral EU industry by integrating SSbD principles into large-scale development projects

- Target 3.1: By 2030, publicly funded large-scale infrastructure and product development projects will demonstrably integrate SSbD principles throughout their lifecycle (EU Clean Industrial Deal, CLP, General Product Safety Regulation, Common data platform on chemicals proposal, Methodological guidance to SSbD).
  - **Action 3.1.1**: Develop mandatory SSbD criteria within EU funding programmes for large-scale projects, prioritising investments that demonstrably contribute to lower environmental and human health impacts, decarbonisation and resource efficiency.
  - **Action 3.1.2**: Implement SSbD in chemical product development trajectories and ensure that the end product is the focal point in the lifecycle analysis (to prevent steering towards the development of low-quality products).

Objective 4: Stimulate innovation of sustainable chemicals, ingredients, processes, and products

- Target 4.1: By 2030, the EU establishes a support programme for the development of wastewater treatment plants for emerging industrial practices Europe (UWWTD, Zero Pollution Parliament).

- **Action 4.1.1**: Develop technology to concentrate hazardous substances, such as PFAS, to enhance the effectiveness of removal and remediation from large water quantities such as streams in wastewater treatment plants.
- **Action 4.1.2**: Develop energy efficient methods and nature-based solutions (e.g. constructed wetlands) that adhere to circular economy principles for the removal of hazardous substances from different environmental matrices and waste streams and subsequent end-of-life treatment.
- **Action 4.1.3**: Invest in wastewater treatment technology for renewed mining activities to secure the supply of critical resources, which should ideally be done without creating environmental harm in those regions where (deep sea) mining takes place.

Objective 5: Promote the use of safer alternatives

- Target 5.1: Phase out the manufacturing, import, and use of the most harmful substances, including all PFAS, to significantly decrease the input of hazardous substances into the natural environment (Communication 2024/2894, Zero Pollution Parliament).
  - **Action 5.1.1**: Start with phasing out hazardous substances in non-essential uses.
  - **Action 5.1.2**: Create clear guidelines for judgement of essentiality and verify these by stakeholder consultation.
  - **Action 5.1.3:** Ensure that the future development of active substances used in biocides, plant protection products and medicinal products adheres to SSbD approaches, similar to substances that fall under REACH.
  - **Action 5.1.4**: Invest public funds into development of SSbD alternative chemicals and materials, both for basic research and applied research.
- Target 5.2: Create a shared responsibility by incentivising companies that use, import or manufacture hazardous substances to invest into the development of SSbD alternatives (Zero Pollution Parliament).
  - **Action 5.2.1:** Companies invest into the development of SSbD alternatives at their own R&D departments or in collaboration with external parties. A system where companies that are successful in finding an alternative should profit the most in the longer term (e.g., via societal incentives to switch to the new chemicals and materials).
  - **Action 5.2.2**: Part of the investment goes into an insurance mechanism that compensates those companies that invested into technologies that turn out to be less successful. This could be a proactive implementation of the polluter-pays principle.
- Target 5.3: 18 months after entry into force of the PFAS restriction proposal, companies that make use of a derogation for PFAS use for a specific application, need to invest a specific percentage of their revenue to develop alternatives (PFAS restriction proposal).
  - **Action 5.3.1**: Following the reporting approach included in the PFAS restriction proposal on the continued use of PFAS under a specific derogation, the EU integrates reporting obligations on the progress companies make towards developing alternatives.

Objective 6: Raise public awareness on levels of hazardous substance pollution

- Target 6.1: By 2030, for areas in which monitoring is in place, a dashboard should be made available by Member States (e.g., PCBs, metals; Zero Pollution Parliament, EEA zero pollution dashboard).

- **Action 6.1.1**: Create a dashboard aggregated value that reflects concentration levels in a certain area of hazardous substances and values that show how harmful certain chemicals are.
- **Action 6.1.2**: Once monitoring operations for certain substances are in place, the dashboard should be expanded to reflect these additions.
- **Action 6.1.3**: Create composite indicators in collaboration with stakeholders (e.g. NGOs) that show the status of hazardous substance pollution, and which can be easily accessed and interpretated by non-experts.

A summary of the above is presented in Table 3 in the Annex .

5. MICROPLASTICS

5.1. Pollutant profile

Emissions of microplastics to the environment are currently estimated to be between 10 and 40 million tonnes per year, and under business-as-usual scenarios, this amount could potentially double by 2040 (Thompson et al. 2024). Between 0.7 to 1.8 million tonnes of microplastics were estimated to be released into the environment in the EU in 2019 (European Commission 2023).

Although there is no internationally agreed-upon definition of microplastics, they are generally understood to be plastic particles smaller than 5 millimetres in size. Within the context of the restriction on intentionally added microplastics under the REACH regulation, microplastics are defined as particles that have: (i) all dimensions 1 nm ≤ x ≤ 5 mm, or (ii) a length of 3 nm ≤ x ≤ 15 mm and a length-to-diameter ratio >3 (European Commission 2023).

Microplastics are generally categorised into two main types: primary and secondary microplastics. Primary microplastics are manufactured for the purpose of being added to (or used in the production of) other products, such as microbeads in cosmetics and personal care products, detergents and industrial abrasives or pre-production plastic pellets (nurdles). Secondary microplastics are the particles formed from the breakdown or degradation of larger plastic items (macroplastics) through processes such as weathering, mechanical abrasion, and chemical breakdown. Examples of secondary microplastics include fragments of plastic macrolitter (i.e., bags, bottles, etc.), tyre wear particles generated from the abrasion of tyres on roads, microfibers released from synthetic clothing during washing, paint flakes, etc.

In addition to microplastics inputs to the environment from the fragmentation of macroplastics, the main releases of microplastics in the EU originate from paints and coatings, tyres, plastic pellets, synthetic textiles, geotextiles and detergent capsules (European Commission 2023).

Microplastics represent a continuum of particle sizes, shapes, colours, densities and polymer compositions, all of which influence their environmental behaviour, bioavailability to organisms and their potential to cause adverse effects. They are ubiquitous in the marine environment and can be found on beaches, the sea surface, the water column and typically

accumulate in sediments. Due to their small size, microplastics can be intentionally and unintentionally ingested by marine organisms, leading to physical harm such as food dilution, gastrointestinal blockage, or internal abrasion and even mortality (Koelmans et al. 2022; Osman et al. 2023; Grattagliano et al. 2025; Maes et al. 2020). Importantly, all synthetic polymer materials used in consumer products contain a mixture of additive chemicals and non-intentionally added substances. Additives provide the polymer materials with specific properties, such as flexibility, protection from UV degradation, flame retardance and colouration, while non-intentionally added substances include residual monomers, production chemicals and degradation/breakdown products (Maes et al. 2023). As they are not bound to the polymer matrix, these chemicals can leach out into the surrounding environment or organisms (ibid.), making microplastics a significant challenge for marine governance and the protection of marine ecosystems (ibid.).

Addressing microplastic pollution from source-to-sea requires a comprehensive understanding of the various microplastic sources, their pathways through the environment, and the different stages of their life cycle. Microplastic pollution can occur across the entire value chain, including during production and manufacturing processes, product use, end-of-life and end-of-pipe stages. As such, the design and composition of plastic products is closely linked to the generation and pathways of microplastic pollution with relevant implications for microplastic pollution governance. Most of the microplastic ending up in the marine environment is transported from land through rivers and atmospheric deposition (Domenech and Marcos 2021). Additional pathways include discharges of wastewater treatment plants, urban and road run off, and mismanaged plastic waste (Veiga et al. 2016; Kay et al. 2018).

5.2. Zero Pollution Vision 2030 Target

Regarding microplastics, the ZPAP sets the Zero Pollution Vision 2030 Target of reducing the microplastics released into the environment by 2030 by 30%. It is envisioned that this will be achieved by restricting the use of intentionally added microplastics in products, minimising unintentional microplastic releases and reducing overall plastic pollution, since larger plastics fragment and degrade into microplastics.

Several policies under the EU Green Deal address the target, including the EU Plastics Strategy, and the Circular Economy Action Plan. These overarching policies are supported by more specific legislation that targets microplastics from various sources. An overview is provided in Table 1 (see Annex Table 1: Policy landscape).

5.3. Key challenges

Based on the research conducted within the SOS-ZEROPOL2030 project, a number of key challenges related to microplastics have been identified (Devriese et al. 2023, 2025):

- The target is defined with specific timeframes, but it is not expressed in quantitative terms (e.g., percentage values). For example, the ZPAP sets a target for reducing microplastics (MPs) in percentages. However, it does not clarify whether this refers to volume, mass, or number of particles, making it difficult to interpret and implement the target effectively.

- The microplastic reduction target is not realistically attainable, mainly due to significant data gaps regarding microplastic fluxes into the environment. There is insufficient information on how to measure these fluxes or even what the actual fluxes are.
- The EC asserts that targeting only primary microplastics would be enough to achieve the overall goal of a 30% reduction in microplastic emissions to the environment. This implies that the REACH restriction (intentionally added MPs) and the pellet regulations are considered sufficient to meet the broader reduction target. However, this assumption cannot currently be validated due to the lack of environmental data on the relative contribution of intentionally added microplastics and pellets to the total microplastic load entering the environment.

5.4. SOS-ZEROPOL2030 objectives, targets, and actions

To achieve the Zero Pollution Vision 2030 Target, the Strategic Zero Pollution Framework identifies the following supporting objectives, targets and associated priority actions – readily implementable, cost-effective, and/or can deliver immediate impact – to address microplastic pollution:

Objective 1: Minimise microplastic release from tyre and road wear into water bodies

- Target 1.1: By year 2036, each Member State has implemented civil engineering solutions retaining or reducing the spread of tyre wear particles in at least 50% of its designated urban areas, prioritising regions with high traffic density and runoff impact (ZPAP, Euro 7 Regulation, Sustainable Urban Mobility Plans, UWWTD).
  - **Action 1.1.1**: Expand road runoff collection, optimise treatment systems and deploy mechanical road cleaning**,** in urban areas prone to high vehicular activity**.**
  - **Action 1.1.2**: Promote the development of particle retention systems at or near roadways – such as permeable pavements, sedimentation basins, roadside vegetation, constructed wetlands – to limit the transport of tyre wear particles via surface water runoff.
  - **Action 1.1.3**: Upgrade urban wastewater treatment plants to enhance the capture and treatment of tyre wear particles before they reach natural water bodies.
  - **Action 1.1.4:** Promote low-abrasion road surface materials and maintenance practices to reduce tyre wear particle generation.
- Target 1.2: By 2036, at least 40% of new vehicles and tyres placed on the EU market comply with enhanced eco-design standards aimed at reducing tyre wear particle emissions and improving overall environmental performance (ESPR).
  - **Action 1.2.1**: Promote the design and mandatory labelling of low-abrasion tyres through EU eco-design requirements (including under the ESPR) and relevant product and vehicle legislation, including the Tyre Labelling Regulation and Euro 7 requirements where applicable.
  - **Action 1.2.2**: Establish EU-wide performance criteria for tyre abrasion and rolling resistance, building on Euro 7 requirements and integrating them into vehicle eco-design requirements under the ESPR and vehicle type-approval frameworks to ensure consistency, enforcement, and continuous improvement in tyre environmental performance.

- **Action 1.2.3:** Support the development, testing, and adoption of on-vehicle tyre wear particle capture technologies through EU research and innovation programmes.

- Target 1.3: By 2030, Member States implement comprehensive policies promoting sustainable driving behaviour and reducing private car dependency in urban areas by at least 20% to lower tyre wear emissions and overall environmental impacts from road transport (Sustainable and Smart Mobility Strategy).
  - **Action 1.3.1**: Develop and expand urban mobility policies that encourage modal shifts, such as improving public transit accessibility, investing in safe cycling and walking infrastructure, establishing low-emission zones and expanding rail infrastructure to reduce reliance on private car use in urban centres.
  - **Action 1.3.2:** Mandate the inclusion of eco-driving modules in all new driver training and licensing programmes, complemented by public campaigns to low tyre-wear driving habits.

Objective 2: Reduce microplastic emissions from synthetic textile fibres through upstream prevention

- Target 2.1: By 2036, reduce the release of microplastics from textile washing and drying processes by at least 50% (Plastics Strategy).
  - **Action 2.1.1**: Introduce mandatory standards requiring all new washing and drying machines sold in the EU from 2030 onwards to be equipped with certified microplastic filtration systems that effectively capture synthetic fibres during washing and drying, as well as clear consumer guidance on how to use them.
  - **Action 2.1.2:** Support research and development into low-shedding fibres and textile products, recognising that fibre shedding varies significantly depending on fibre type (e.g. natural, synthetic, and blended fibres), yarn construction, fabric structure, and manufacturing and finishing processes. A more detailed understanding of these parameters is necessary to effectively reduce fibre release across different textile categories.
  - **Action 2.1.3:** Implement consumer awareness campaigns on reducing environmental fibre release through washing frequency, laundering practices and garment choice, while recognising that further data is needed to strengthen the evidence base for specific recommendations on garment selection.

Objective 3: Prevent unintentional plastic pellet losses across the entire plastics supply chain

- Target 3.1: By 2030, achieve at least a 30% reduction of plastic pellet losses across the entire plastics supply chain in the EU (Plastics Strategy).
  - **Action 3.1.1**: Mandate binding EU-wide regulations requiring all plastic producers, converters, and transporters to implement standardised containment and spill prevention measures, including secure storage, handling protocols, incident reporting, and preventive measures such as container air bags and optimized transport methods (e.g., local production, limiting transport via waterways), in alignment with relevant international frameworks including ongoing work under the IMO for maritime transport.

- **Action 3.1.2:** Develop pellet fingerprinting and traceability systems to differentiate operational versus transport-related losses, assign accountability, and support enforcement across the supply chain.

Objective 4: Enhance microplastic capture and removal in urban wastewater and stormwater systems

- Target 4.1: By 2030, at least 50% of municipalities within each Member State have implemented wastewater and stormwater treatment solutions to effectively capture and remove microplastics before they enter waterways (Plastics Strategy, UWWTD).
  - **Action 4.1.1**: Expand and optimise stormwater collection and treatment systems in urban areas to reduce microplastic loads entering wastewater and surface water pathways.
  - **Action 4.1.2**: Upgrade urban wastewater treatment plants and incorporate nature-based solutions, including constructed wetlands, to enhance microplastics capture before they reach natural water bodies.
  - **Action 4.1.3**: Establish limits for microplastics in sewage sludge applied to agricultural land.
  - **Action 4.1.4**: Introduce mandatory monitoring and reporting of microplastic removal efficiency in WWTPs, including microplastic concentrations in influent, effluent, and sludge, to enable assessment of treatment performance and residual emissions.

Objective 5: Reduce microplastic emissions from paints, coatings, and industrial surfaces

- Target 5.1: By 2040, all industrial surfaces and coatings in the EU adopt sustainable materials and technologies that minimise microplastic release during use and degradation (Zero Pollution Action Plan, Chemical Strategy for Sustainability).
  - **Action 5.1.1:** Promote the development of durable, sustainable coatings with minimal degradation.
  - **Action 5.1.2:** Explore alternative surfacing technologies for cars, ships, new builds, and industrial applications.
  - **Action 5.1.3:** Implement coatings and industrial materials with controlled/programmed biodegradability, applied only where appropriate, ensuring that valuable components are recovered prior to degradation and that biodegradation occurs under controlled conditions at end-of-life to minimise microplastic release.

Objective 6: Reduce microplastic emissions from fertilisers and soil

- Target 6.1: By 2030, minimise microplastic contamination in agricultural soils and fertilisers through the adoption of sustainable practices, monitoring, and mitigation measures (Farm to Fork Strategy, Chemicals Strategy for Sustainability, Fertilizer Regulation 2019/1009).
  - **Action 6.1.1:** Identify and assess all sources of microplastics in fertilisers and agricultural soils, including unintentional releases, to inform targeted mitigation measures and support compliance with REACH microplastic restrictions.
  - **Action 6.1.2:** Align mitigation strategies with climate-smart agricultural practices and soil management systems to ensure microplastic reduction is integrated with sustainable crop and soil management.

- **Action 6.1.3:** Promote research and implementation of nature-based solutions, such as buffer zones, cover crops, and soil filtration techniques, to prevent microplastic accumulation in soils.
- **Action 6.1.4:** Introduce monitoring and reporting mechanisms for microplastic levels in fertilisers and agricultural soils to track progress and inform future policy adjustments.

A summary of the above is presented in Table 4 in the Annex.

6. UNDERWATER NOISE

6.1. Pollutant profile

Underwater noise (UWN) is sound introduced into the ocean by human activities, such as shipping, use of recreational vessels, offshore construction, seismic surveys, and naval sonar, which increasingly dominate over natural sounds from waves, wind and marine life. Anthropogenic sound sources are classified into impulsive and continuous (ambient) (Dekeling et al. 2014). Impulsive sound sources include construction and operation of offshore facilities, seismic surveys (using airguns), explosions, dredging and geological prospecting, among others, while continuous sound sources include shipping (Klauson et al. 2024). Underwater sound from anthropogenic sources has the potential to mask biological signals and to cause behavioural reactions, physiological effects, injuries and mortality in marine animals (Tasker et al. 2012). Impacts depend on both the nature of the sound and the acoustic sensitivity of the organism. While continuous noise, from ship engines and propellers, occurs persistently and affects large areas, impulsive noise consists of short, intense bursts that can travel great distances and cause immediate harm. There is great variability in the characteristics of the sounds, the sensitivities of different species and the scale of noise-generating activities, which make it difficult to quantify the extent and scale of the impacts.

Underwater noise is unlikely to pose a threat to human health, but it does directly affect marine animals due to the disruption of the natural ocean soundscape, interfering with marine species' communication, navigation, feeding, and breeding. Specifically, prolonged exposure to underwater noise can lead to animal stress, hearing damage, and habitat displacement, threatening marine biodiversity and ecosystems (Devriese et al. 2023). As impacts of sound are not well understood in many animal species, managing and governing underwater noise is complex.

6.2. Zero Pollution Vision 2030 Target

The ZPAP aims to reduce underwater noise to levels that do not adversely affect populations of marine animals (as implemented by MSFD) (European Environment Agency and European Commission Joint Research Centre 2025; European Commission 2017). The EU has set binding limits for underwater noise pollution under the MSFD, aiming to reduce underwater noise by setting EU threshold values. According to MSFD Descriptor 11 C1 (impulsive noise), no more than 20% of a marine habitat can be exposed to impulsive noise over a given day, and no more than 10% over a year. Similarly, no more than 20% of a given marine area, can be exposed to continuous underwater noise over a year, as per Descriptor 11 C2 (continuous

noise). Despite these thresholds being introduced, the sound pressure levels that constitute adverse effects to populations of marine animals are not fully understood. EU Member States will now need to take these threshold values into account when they update their marine strategies and eventually take actions in their programmes of measures, also with the support of the Regional Sea Conventions.

However, short- and medium-term progress in reducing shipping-related underwater noise remains relatively slow, due to the gradual replacement of noisy ships and growing global traffic (European Environment Agency and European Commission Joint Research Centre 2025). To address this, the European Maritime Safety Agency's (EMSA) NAVISON project has developed forecast models to evaluate the impact of various mitigation strategies for reducing Underwater Radiated Noise (URN) (European Maritime Safety Agency 2025a). Foresight analysis indicates that the implementation of technical and operational URN and greenhouse gas (GHG) mitigation measures may lead to a substantial reduction in URN for all ship types and in all regions by 2050 (Vakili et al. 2023; European Maritime Safety Agency 2025b). In specific cases, this reduction could be as much as 70% compared to the business-as-usual scenario (European Maritime Safety Agency 2025b; IFAW, n.d.). Efforts at national, EU and international levels, alongside the adoption of new technologies and operational practices, will be crucial to achieving this reduction. However, shipping is regulated internationally under the International Maritime Organization (IMO), and it remains under consideration whether addressing underwater noise will be coordinated jointly by EU Member States or at the national level. The resulting governance arrangement will influence the pace and scope of policy implementation (European Maritime Safety Agency 2025b; International Maritime Organization 2023).

Achieving the Zero Pollution Vision 2030 for UWN requires not only compliance with MSFD threshold values, but also a precautionary, ecosystem-based approach that addresses cumulative and transboundary impacts of both continuous and impulsive sound sources. Given the ability of sound to propagate over large distances and affect highly mobile marine species, coordinated action at regional sea-basin level is essential. Progress towards the 2030 target depends on the availability of harmonised definitions, metrics, and assessment methodologies for underwater noise, including the Level of Onset of Biologically Adverse Effects (LOBE) and agreed temporal and spatial observation windows, while recognising that tangible progress will require the effective implementation of measures to reduce noise. Achieving policy objectives and reductions in UWN will require coordinated investment in monitoring infrastructure, data collection, and reporting frameworks across Member States and sectors. In this context, the planned European Ocean Observation Initiative under the Ocean Act provides an important opportunity to enhance coherence, efficiency, and integration of UWN monitoring efforts. A more centralised or coordinated approach, building on existing EU and regional mechanisms could support interoperability, reduce duplication, and strengthen data accessibility, while remaining aligned with evolving governance arrangements and international obligations. These elements are necessary to ensure comparability of assessments across Member States and to support effective prioritisation of mitigation measures. In line with the precautionary principle, interim noise reduction measures should be implemented even where scientific uncertainty remains, particularly in ecologically sensitive areas such as breeding, spawning, and feeding grounds. Integration of

underwater noise considerations into Marine Spatial Planning (MSP), Environmental Impact Assessments (EIA), and sectoral policies will be critical to balancing marine ecosystem protection with sustainable Blue Economy development.

6.3. Key challenges

Based on the research conducted within the SOS-ZEROPOL2030 project (Devriese et al. 2023, 2025) and in EU funded research projects focused on UWN (such as SATURN, JOMOPANS, JONAS) (Ainslie et al. 2023), a number of key challenges related to UWN and underwater sound have been identified:

- Underwater (radiation) noise levels are increasing across Europe's seas, driven by expanding maritime activities in the growing Blue Economy, where full noise reduction is not feasible.
- There is often no established causal link between observed levels of UWN and demonstrated adverse effects on populations of marine animals.
- The ZPAP objective, based on MSFD thresholds, remains difficult to fully interpret due to current knowledge gaps about environmental harm and the contributions of different emission sources.
- The lack of harmonised standards, terminology, and assessment windows (e.g., LOBE, Temporal Observation Window (TOW) and Spatial Observation Window (SOW) limit the comparability of UWN assessments and complicates interpretation of MSFD thresholds.
- Standardised approaches to the modelling of cumulative effects of noise emanating from multiple anthropogenic sources and/or activities are not routinely employed on a regional basis.

6.4. SOS-ZEROPOL2030 objectives, targets and actions

Following the Zero Pollution Vision 2030 Target, the following objectives, targets and actions to address UWN and achieve the Zero Pollution Ambition by 2030 have been identified:

Objective 1: Reduce underwater noise from shipping and other vessels

Shipping is the dominant source of continuous low-frequency underwater noise in European seas. Reducing noise from vessels requires a combination of technological innovation, operational measures, and spatial management, supported by incentives and regulatory alignment at EU, national and international levels.

- Target 1.1: By 2030, a 2 dB underwater noise reduction is achieved (with consideration of a more ambitious 3 dB reduction) (MSFD, MSP Directive, ZPAP, IMO guidance and Guidelines).
  - **Action 1.1.1**: Establish quiet zones by 2026 through MSP in ecologically sensitive areas, supported by sound maps and species distribution data, and implemented via routing measures, speed limits, or access restrictions for noisier vessels.
  - **Action 1.1.2**: Slow down shipping through implementation of speed reduction schemes on a voluntary basis in priority areas, supported by port incentives and digital traffic management tools, and aligned with greenhouse gas mitigation objectives.

- **Action 1.1.3**: Improve ship design by promoting the adoption of low-noise propellers, hull forms, and vibration isolation technologies in new builds and retrofits, including through incentives, funding mechanisms, and support for research into cost-effective engineering solutions, while leveraging synergies with energy-efficiency and decarbonisation requirements.

- Target 1.2: By 2050, a 6 dB underwater noise total reduction is achieved (MSFD, IMO Guidelines, long term fleet renewal strategies, classification society rules).
  - **Action 1.2.1: Integrate noise considerations into ship design processes** starting 2030–2035. Embed underwater noise performance as a design parameter alongside emissions and safety in EU and IMO standards, classification rules, and procurement requirements.
- Target 1.3: By 2027, a harmonised European underwater noise index to guide port policies and ship incentives is developed (MSFD, port incentives and green port strategies, Zero Pollution Parliament).
  - **Action 1.3.1:** By 2029 30% of EU ports, which includes the national primary ports in EU countries, adopt a noise ship index in line with IMO recommendations. within their environmental programmes, referring to scientific outputs (e.g., SATURN project).
  - **Action 1.3.2**: By 2040, the noise ship index is expanded to 60% of EU ports adopting the index for progressive harmonisation across Member States, supported by the European Maritime Safety Agency (EMSA) and regional cooperation.
  - **Action 1.3.3**: By 2050 100% of EU ports have adopted the index, supporting consistent application of URN benchmarks and environmental labelling. The index should be linked to port fee differentiation, priority berthing, and environmental labelling schemes.

Objective 2: Establish consistent underwater noise monitoring and reporting infrastructure

Effective management of underwater noise depends on interoperable monitoring systems capable of capturing spatial, temporal, and source-specific patterns, supporting MSFD reporting and sound mapping.

- Target 2.1: By 2035, establish a functional, interoperable underwater noise monitoring and reporting network covering key maritime areas, which could, where appropriate, adopt a risk-based prioritisation approach focusing on busier and higher-pressure sea areas, in alignment with MSFD provisions, contributing to a measurable reduction in noise pollution impact on marine ecosystems (MSFD, Regional Seas Conventions, sound mapping initiatives, ISO standards).
  - **Action 2.1.1**: Establish monitoring stations in high-traffic areas with shared cost models (public and private). Priority should be given to ports, shipping corridors, offshore energy zones, and marine protected areas.
  - **Action 2.1.2**: By 2035, 30% of vessels (including fishing vessels) are baselined for noise emissions. Baselining should follow harmonised protocols aligned with ISO 7605 and ISO 17208-3.
  - **Action 2.1.3**: Gaps in military and non-commercial vessel data are addressed, following MSFD reporting obligations; confidential or aggregated reporting approaches, as well as NATO and national mitigation frameworks.

- **Action 2.1.4**: Reliable data upload, harmonised standards, and improved communication between stations is ensured. Harmonisation is supported through ISO standards (ISO 7605, ISO 17208-3, ISO 23990) and EU Harmonise project.
- **Action 2.1.5**: Underwater noise reporting is embedded into environmental performance metrics across the maritime sector. Integration into Environmental, Social, and Governance (ESG) reporting, considering impacts on the environment (E), such as emissions, pollution, resource use, biodiversity impacts (including underwater noise in a maritime context), impacts on people and communities, including worker safety, human rights, community impacts, and stakeholder engagement (S), and how an organisation is managed and governed, including transparency, accountability, risk management, and compliance reporting, port environmental programmes, and sustainability indicators (G).

Objective 3: Develop an integrated approach to strengthen public awareness, enable informed choices, and clearly communicate the sector's commitment to greener, quieter passenger and goods transport

Awareness and transparency are essential to build acceptance of mitigation measures and encourage behavioural and market-driven change.

- Target 3.1: Integrate underwater noise awareness into maritime training and ship design (Zero Pollution Action Plan, EU environmental labelling initiatives).
  - **Action 3.1.1:** Early awareness campaigns, mandatory training modules, and educational content (e.g., documentaries) as part of career development in maritime sectors and in ship design.
  - **Action 3.1.2:** Technical training for engineers and maritime personnel is integrated into qualifications for maritime sectors and boating licences. Training should address both continuous and impulsive noise sources, mitigation technologies, and regulatory requirements.
- Target 3.2: Enhance consumer engagement through transparent information on the environmental performance of maritime transport, presented as part of a combined, comprehensive environmental labelling approach.
  - **Action 3.2.1**: Explore opportunities to communicate the environmental performance of maritime transport to consumers through digital information tools or labelling approaches, including information on underwater noise reduction and GHG emissions.
  - **Action 3.2.2**: Cruise ships, passenger vessels, and ferries provide on-board displays or short videos showcasing their efforts to reduce Underwater Radiated Noise alongside other green measures, creating a single, unified message on environmentally friendly maritime transport.

Objective 4: Reduce and manage impulsive underwater noise

- Target 4.1: By 2030, impulsive noise events are systematically recorded, assessed, and mitigated across EU marine regions (MSFD, OSPAR/HELCOM Impulsive Noise Registers, QUIETMED/QUIETSEAS, ACCOBAMS and ASCOBANS guidance).
  - **Action 4.1.1:** Establish and harmonise impulsive noise registers across regional seas, drawing on existing examples, e.g., OSPAR impulsive noise register.

- **Action 4.1.2:** Promote alternatives to high-intensity impulsive sources (e.g., vibroseis, low-order deflagration, non-impact foundations). SONIC, AQUO, UXO deflagration research investigates methods for neutralising explosives using controlled, low-order reactions that release energy gradually, rather than through a high-order detonation, thereby significantly reducing peak sound pressure levels and environmental impacts.
- **Action 4.1.3:** Apply spatial and seasonal restrictions in sensitive habitats through MSP, building on coordination mechanisms such as the Greater North Sea Basin Initiative (GNSBI), which can support alignment and regional coherence of national Marine Spatial Plans across Member States while respecting their individual planning competencies, and providing a framework to better account for the transboundary nature of underwater noise propagation and cumulative impacts.

Objective 5: Integrate underwater noise into Marine Spatial Planning

- Target 5.1: By 2030, underwater noise considerations are systematically integrated into MSP processes (MSP Directive, MSFD programmes of measures, cumulative effects assessment frameworks, EU Nature Directives, EIA and SEA Directives).
  - **Action 5.1.1:** Use sound maps and cumulative effects assessments to inform spatial allocation of activities.
  - **Action 5.1.2:** Identify and protect low-noise refuge areas and ecologically sensitive soundscapes.
  - **Action 5.1.3:** Align MSP measures with MSFD programmes of measures and EIAs for cross-sectoral planning coherence.

Objective 6: Establish harmonised standards, definitions, and assessment frameworks

- Target 6.1: By 2028, harmonised terminology, metrics, and observation windows are adopted across EU underwater noise assessments (ISO standards, TG Noise recommendations, scientific outputs, MSFD).
  - **Action 6.1.1:** Support adoption of ISO 23990, ISO 7605, and ISO 17208-3.
  - **Action 6.1.2:** Harmonise definitions for LOBE, Temporal Observation Windows (TOW), and Spatial Observation Windows (SOW), aligned with TG Noise recommendations and scientific terminology work (e.g., SATURN project).
  - **Action 6.1.3:** Develop EU guidance for verification and validation of sound maps, aligned with scientific work (e.g., NAVISON, JOMOPANS, SATURN Projects).

A summary of the above is presented in Table 5 in the Annex.

7. UNDERPINNING ACTIONS ACROSS THE FOUR POLLUTANTS

7.1. Stepping stones to support policy action

Cross-cutting actions are necessary to underpin pollutant-specific actions across the four pollutants, as well as for supporting the effectiveness of EU policies, including the future Ocean Act. Such opportunities are stepping stones to improve or advance pollution policy and its many, interrelated components, thereby overcoming identified cross-cutting challenges to marine pollution governance. Stepping stones focus on management practices, implemented across an array of policies, to ensure progress towards the environmental and management

objectives that they are intended to achieve. The following stepping stones have been identified to support policy action for the four pollutants (Devriese et al. 2023, 2025):

- **Clear scope and targets**: Successful governance relies on clear objectives establishing overarching responsibility and goals. Targets must meet standards, as well as being understandable, be as specific as possible and (methodologically) feasible.
- **Knowledge as scientific advice for policy**: Knowledge allows for science-based and informed decision making and policy actions. Specific knowledge is needed to define meaningful targets and measures. Knowledge gaps on environmental risks, source emissions and transport pathways into and within the marine environment should be filled in accordance with the needs of the policy context.
- **Stakeholder inclusive policy design and implementation**: Stakeholder engagement helps to facilitate transparent communication of knowledge and awareness raising, access to information, as well as stakeholder participation via consultative processes and an established science-policy-society interface.
- **Policy evaluation and adaptive management**: Encompasses policy coordination between EU policies, environmental targets and assessments, and includes evaluation provided through frameworks and reporting to monitor progress.
- **External dimension and global cooperation**: Alignment through international and regional cooperation.

7.2. SOS-ZEROPOL2030 objectives, targets and actions

The following objectives, targets and actions to underpin pollutant-specific actions and achieve the Zero Pollution Ambition by 2030 have been identified:

Objective 1: Foster a community of practice and ensure cooperation and coordination across relevant stakeholder and expert groups

- Target 1.1: By 2030, establish a community of practice within the EU considering source-to-sea pollutant pathways and including diverse stakeholders and perspectives (Zero Pollution Parliament).
  - **Action 1.1.1:** Create multi-expert working groups (for specific pollutants) with experts from Member States, the EU and regional sea bodies that span different types of knowledge (e.g., including human health) to foster exchange and dialogue on existing challenges and best practices, as well as address specific issues considering identified pollutant pathways.
  - **Action 1.1.2:** Establish an EU-wide multi-stakeholder platform for pollutants that includes diverse knowledge hubs (e.g., health and environment) from across the source-to-sea approach in an effort to align regional and national priorities and actions through enhanced cooperation and exchange.

Objective 2: Increase transparency and knowledge of pollutants on environmental risks, source emissions and transport pathways into the marine environment to raise awareness

- Target 2.1: By 2030, raise awareness and boost knowledge among citizens about the potential exposure risks to pollutants (Zero Pollution Parliament).

- **Action 2.2.1:** Create a public facing poly-pollutant risk information platform to provide EU citizens with access to knowledge and information concerning potential risks, including on human health, from pollutants in the marine environment.

Objective 3: Improve monitoring and evaluation of progress towards policy objectives and underpin enforcement

- Target 3.1: By 2030, establish an EU mechanism to measure progress towards EU policy targets as part of the future EU Ocean Dashboard under the Ocean Act (Zero Pollution Parliament).
  - **Action 3.1.1**: Expand upon the European Environment Agency's (EEA) Zero Pollution Dashboards and Monitoring tool by developing an online EU pollution policy tracking tool that takes into account the source-to-sea approach and includes the latest policy updates and revisions, changes in industry standards, ongoing reporting deadlines and requirements, and compliance challenges.
  - **Action 3.1.2:** Directly address key gaps in knowledge as outlined in the EEA's Pollution Monitoring and Outlook 2025, such as clear and precise definitions of pollutants and targets, understanding about potential risks to human health, transboundary pollutants, and cumulative impacts caused by the synergistic effects of multiple pollutants in the marine environment.
  - **Action 3.1.3**: Establish an EU pollution task force, including representatives from e.g., government, industry, research, civil society and certification bodies, to assess progress towards EU pollution policy targets and advise the Ocean Board on policy effectiveness, identified challenges and gaps.

Objective 4: Strengthen regulatory frameworks and promote best practices to prevent pollution within the EU and beyond

- Target 4.1: Strengthen the existing regulatory and governance framework addressing pollution in the EU including at the regional and international level (Zero Pollution Parliament).
  - **Action 4.1.1:** Create EU-wide guidelines and best practices for addressing pollution and implementing existing EU policies through the source-to-sea approach.
  - **Action 4.1.2:** Fund research and innovation projects through EU mechanisms targeting the improvement of policy and governance across the source-to-sea approach, focusing on policy design and implementation of existing and established EU and Member State policies.
  - **Action 4.1.3:** Continue to support the international dimension of global pollution governance, for example by taking a leading role in global negotiations for a Plastics Treaty and supporting existing global agreements.

A summary of the above is presented in Table 6 in the Annex.

8. SUMMARY AND OUTLOOK

The Strategic Zero Pollution Framework proposes critical building blocks to progress toward the Zero Pollution vision set out under the European Green Deal. Following a source-to-sea approach, it is essential to tackle identified challenges for each of the four priority pollutants: nutrients, hazardous substances, microplastics and underwater noise, acknowledging the complexity in their specific sources, characteristics, effects and pathways. However, it must be broad enough in scope to also cover other types of pollution not covered in detail within the current study, as well as adaptable to including emerging forms of pollution in the future.

While the EU has placed (marine) pollution prevention and reduction at the forefront of its environmental agenda through the Zero Pollution Action Plan, further coordinated and urgent action is needed to ensure healthy and productive marine ecosystems. The Strategic Zero Pollution Framework provides guidance on essential next steps to achieve the vision set out in the EU Green Deal for the four priority pollutants (nutrients, underwater noise, microplastics, contaminants). The Strategic Zero Pollution Framework outlines the pollutant profile, the zero pollution 2030 vision target, key challenges and gaps, objectives, targets, actions and timelines, as well as the key stakeholders that are needed to affect the necessary and desired change.

An effective and implementable plan is crucial for sustaining momentum in long-term governance initiatives like achieving zero pollution by 2030 in European Seas and to implement the source-to-sea approach, inherent to the Strategic Zero Pollution Framework. In a next step, SOS-ZEROPOL2030 will deliver a roadmap to operationalise the Framework and its identified actions to set out a detailed strategy and offer practical advice for achieving its objectives and targets.

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ANNEX

Table 1: Policy landscape

Policy name	Description	Pollutant group(s)
1991 Nitrates Directive (91/676/EEC)	Sets out measures to reduce nutrient water pollution from agriculture by promoting the use of good farming practices, monitoring nitrate concentrations of water bodies.	Nutrient inputs
1992 Habitats Directive (92/43/EEC)	Sets out measures to protect habitats and species inside and outside Natura 2000 sites.	N.A.
2006 Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) Regulation (EC 1907/2006)	Establishes registration and information requirements for manufacturers and importers when placing a product on the market and in manufacturing processes; addresses intentionally added microplastics; excludes textiles, paints. Information on properties of chemicals (registration), monitoring and managing risk of chemicals (authorisation and restriction); authorisation requirement for use of chemicals that are CMR, PBT or vPvB, or that are identified from scientific evidence as causing probably serious effects on humans or the environment.	Microplastics, Hazardous substances
2008 Marine Strategy Framework Directive (2008/56/EC)	Reduce eutrophication and achieve good status in coastal waters and sea by setting targets in relation to nutrient levels. Descriptor 8 to assess level of concentrations of contaminants in marine waters. Monitoring of microplastics in marine water (coastlines, sea surface, seabed sediment).	Nutrient inputs, hazardous substances, microplastics, underwater noise
2009 Plant Protection Product Regulation ((EC) 1107/2009)	Establishes authorisation process for PPPs for use in member states, ensuring that only products that are safe for humans, animals, and the environment can be sold and used.	Hazardous substances
2010 Industrial Emissions Directive (2010/75/EU)	Regulates emissions of chemical pollutants to the environment, sets the requirements for the quality and monitoring of air, water and soil, monitoring and managing risk of chemicals, environmental protection, monitoring and workers legislation.	Nutrient inputs, hazardous substances
2011 Textile Labelling Regulation (upcoming revision) (EU 1007/2011)	Information on care and washing guidelines linked to microplastic emissions, as well as end-of-life disposal instructions for textile products are under consideration.	Microplastics
2012 Biocidal Product Regulation ((EU 528/2012)	Establishes authorisation process for biocidal products and substances contained in those products, as well as exclusion criteria	Hazardous substances
2014 Maritime Spatial Planning Directive (EU 2014/89)	Establishes a framework for maritime spatial planning for sustainable growth of maritime economies, the sustainable development of marine areas and the sustainable use of marine resources.	N.A.
2016 National Emission Reduction Commitments (NEC) Directive (EU 2016/2284)	Sets national emission reduction commitments for Member States and the EU for PM2.5, NOx, NMVOCs, NH3 and SO2. Regulates emissions of chemical pollutants to the environment, sets the requirements for the quality and monitoring of air, water and soil.	Nutrient inputs, hazardous substances

Policy name	Description	Pollutant group(s)
2018 Plastic Strategy (COM/2018/28 final)	Microplastic capture and removal; labelling and requirements for products	Microplastics
2019 Fertiliser Regulation (EU 2019/1009)	Reduce nutrient inputs across the EU in the coming years to improve ecosystems.	Nutrient inputs
2019 Single-use Plastics Directive (EU 2019/904)	Addresses the most littered single-use plastic products and fishing gear; bans oxo-degradable plastic products.	Microplastics
2019 European Green Deal (COM/2019/640 final)	Measures to tackle the unintentional release of plastics	Microplastics
2020 Drinking Water Directive (EU 2020/2184)	Sets additional limits for PFAS as a group of substances.	Hazardous substances (PFAS)
2020 EU Biodiversity Strategy (COM/2020/380)	Sets targets and commitments for biodiversity recovery (e.g., protected areas, nature restoration, targets to reduce the risk of hazardous pesticides and to reduce losses of nutrients from fertilisers).	Nutrients, hazardous substances
2020 Farm to Fork Strategy (COM/2020/381)	Aims to make food systems fair, healthy and environmentally-friendly, e.g., by setting pesticide targets.	Nutrients, hazardous substances
2020 Sustainable and Smart Mobility Strategy (COM/2020/789 final)	Sets targets and commitments for the green and digital transformation of the EU transport system.	Microplastics
2020 Chemical Strategy for Sustainability (COM/2020/667 final)	Minimising and substituting chemical substances of concern (that have chronic effects for human health or the environment), phase out most harmful substances in non-essential uses in particular in consumer products; creates toxic-free hierarchy (prevention over minimising and controlling the risk and over eliminating and remediating pollution).	Hazardous substances
2020 Circular Economy Action Plan (COM/2020/98 final)	Prevent and remove hazardous and persistent substances from contaminating secondary raw material cycles.	Hazardous substances
2020 Tyre Labelling Regulation (EU 2020/740)	Informs consumers when purchasing tyres; based on parameters (rolling resistance, wet grip, external noise); provision to include a parameter for tyre abrasion to be depicted on the tyre label.	Microplastics
2021 Zero Pollution Action Plan (EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil') (COM/2021/400 final)	Establishes 30% reduction target of microplastics released into the environment by 2030.	Microplastics
2023 General Product Safety Regulation (EU 2023/988)	Establishes framework to ensure that all consumer products on the EU market are safe.	N.A.
2023 Regulation on maximum levels for certain contaminants in food (EU 2023/915)	Sets additional limits for four PFAS in a series of foodstuffs.	Hazardous substances (PFAS)
2023 Proposed Regulation on preventing pellet losses to reduce microplastic	Handle plastic pellets at all stages of the supply chain, both on land and sea (including in maritime transport) and establish clean-up obligations.	Microplastics

Policy name	Description	Pollutant group(s)
pollution (trialogue negotiations ongoing) (COM/2023/645 final)		
2023 Common Agricultural Policy	Sets out measures to reduce nutrient water pollution from agriculture through sustainable nutrient management.	Nutrient inputs
2024 Communication 2024/2894 on guiding criteria and principles for the essential use concept in EU legislation dealing with chemicals	Intends to limit the use of the most harmful chemicals to situations where it can be demonstrated that these are necessary for health or safety or serve an essential function to society, and that there are no acceptable alternatives.	Hazardous substances (PFAS)
2024 Revised Regulation on the Classification, Labelling and Packaging of substances and mixtures (CLP) (EU 2024/2865)	Identification of physical, health, environmental or other hazards of a substance or mixture, sets out requirements for classification and labelling.	Hazardous substances
2024 Ecodesign for Sustainable Products Regulation (ESPR) (EU 2024/1781)	Promotes safe and sustainable chemicals, materials and products. Eco-design requirements for specific product groups, including tyres, paints, textiles.	Hazardous substances, microplastics
2024 Industrial Emissions Portal Regulation (IEPR) ((EU) 2024/1244)	Provides easily accessible data on pollutant releases to air, water and land as well as off-site transfers of waste and of pollutants in wastewater.	Hazardous substances
2024 Revised Urban Wastewater Treatment Directive (UWWTD) (EU 2024/3019)	Monitoring of microplastics and micropollutants in emissions from urban wastewater treatment plants and in sludge.	Microplastics
2024 Euro 7 regulation (EU 2024/1257)	Thresholds for tyre abrasion and the development of a harmonised tyre abrasion measurement method; worst performing tyres will be banned from being sold on the market.	Microplastics
2008 and 2025 amendment Waste Framework Directive (2008/98/EC & Directive (EU) 2025/1892)	Establishes waste hierarchy, Extended Producer Responsibility and end of waste criteria for recycling.	Microplastics
2025 Packaging and Packaging Waste Regulation (EU 2025/40)	Increases reuse and recyclability of packaging, as well as targets for recycled plastic content to reduce waste.	Microplastics
2023 and 2025 REACH PFAS restriction proposal	Seeks to restrict all non-essential uses of PFAS and where necessary replace PFAS with less harmful alternatives.	Hazardous substances (PFAS)
2025 Clean Industrial Deal (EU 2025/85)	Sets out measures to boost production stages with a focus on energy-intensive industries and the clean-tech sector for competitiveness and decarbonisation.	N.A.
2025 Regulation (EU 2025/2455) establishing a common data platform on chemicals, laying down rules to ensure that the data contained in it are findable,	Establishes a common digital platform on chemicals managed by ECHA to centralise and integrate chemical data from ECHA, EEA, EFSA, EMA and EU-OSHA and collect information derived from over 70 EU legal acts, e.g. REACH, CLP, regulations on cosmetics, food, pesticides, biocides, and medicinal products.	Hazardous substances

Policy name	Description	Pollutant group(s)
accessible, interoperable and reusable and establishing a monitoring and outlook framework for chemicals		
2025 European Chemicals Industry Action Plan (COM/2025/530)	Strengthen the competitiveness and modernisation of the chemical industry sector through the establishment of a Critical Chemical Alliance, implementation of the Affordable Energy Action Plan to reduce high energy costs, boost demand for clean chemicals and minimise PFAS emissions through a robust, science-based restriction, while ensuring continued use in critical applications under strict conditions where no alternatives are available.	Hazardous substances (PFAS)
2025 EU Ocean Pact (COM/2025/281 final)	The European Ocean Pact brings together the European Union's policies and actions related to the ocean and creates a unified and coordinated plan for managing the ocean.	Nutrient inputs, hazardous substances, microplastics, underwater noise
2000 and 2026 amendment Water Framework Directive (2000/60/EC)	Establishes list of priority substances and watch list of EU-wide concern to assess chemical status of water bodies. Aims to reduce eutrophication and to achieve good ecological status in freshwater and coastal waters by setting targets in relation to nutrient levels. A 2026 amendment (Council of the European Union 2026; European Parliament, n.d.) introduces the obligation to use effect-based monitoring methods in surface water.	Hazardous substances, Nutrient inputs
(upcoming) Integrated Nutrient Management Action Plan (INMAP)	Help reduce nutrient losses by at least 50%, while ensuring that there is no deterioration in soil fertility; develop a holistic approach to the nutrient cycles, covering all sectors and environmental compartments involved in the nitrogen and phosphorus cycles.	Nutrient inputs

Table 2: Nutrients objectives, targets and actions

Objective	Relevant Nutrients/ Nitrogen Forms	Target	Action	Challenge Addressed	Policy Reference / Notes
1. Improve nutrient management in agriculture to reduce losses at source	NH_3, NO_3^-	1.1 By 2030, each Member State has reduced nutrient (nitrogen, e.g., NH_3 and NO_3^-) losses by at least 50%, prioritising high-risk areas with intensive farming and high runoff potential.	1.1.1 Implement precision fertilisation, adjust timing and method of fertiliser and manure application, adopt nutrient-efficient crops, and optimise slurry storage.	Complexity of nutrient cycles, diffuse emissions, multiple sectors and compartments. Hard-to-measure nutrient losses; diffuse agricultural sources; climate and weather variability.	Farm to Fork Strategy (COM/2020/381), Zero Pollution Action Plan (COM/2021/400)
	P	1.2 By 2030, each Member State has reduced phosphorus losses to water bodies by at least 30%.	1.2.1 Mandate phosphorus-based soil testing, implement buffer strips, cover crops, and soil conservation measures along waterways.	Complexity of nutrient cycles, diffuse emissions, multiple sectors and compartments. Hard-to-measure nutrient losses, diffuse runoff, legacy phosphorus in soils.	Nitrates Directive (91/676/EEC), CAP Strategic Plans
	NH_3	1.3 By 2030, all farms minimise NH_3 emissions from livestock and manure management by 25%.	1.3.1 Introduce low-emission manure spreading, improve barn ventilation, manage manure storage.	High ammonia emissions, mitigation insufficient, multiple sectors and compartments. High NH_3 emissions from diverse applications, high costs, farmer compliance.	NEC Directive (2016/2284/EU), Farm to Fork Strategy (COM/2020/381)
	NO_3^-	1.4 By 2027, all farms in Nitrate Vulnerable Zones fully comply with maximum nitrogen application limits.	1.4.1 Monitor soil and water nitrate levels, enforce limits, provide advisory support.	Complexity of nutrient cycles and diffuse emissions, multiple sectors and compartments. Intensive monitoring and enforcement, regulatory	Nitrates Directive (91/676/EEC)

Objective	Relevant Nutrients/ Nitrogen Forms	Target	Action	Challenge Addressed	Policy Reference / Notes
				compliance, regional heterogeneity	
2. Reduce atmospheric nutrient pollution and ecosystem deposition	NH_3, NO_x,	2.1 By 2030, Member States reduce ammonia (NH_3) and nitrogen oxides (NOx) deposition in sensitive ecosystems by 25%.	2.1.1 Implement sectoral emission reduction programmes, cleaner technologies, enforce national ceilings.	High emissions, mitigation insufficient, multiple sectors and compartments. Transboundary; sources across sectors; ecosystems exceeding critical nitrogen loads.	NEC Directive (2016/2284/EU)
	NO_x	2.2 By 2030, all industrial installations apply Best Available Techniques (BAT) to limit NO_x emissions.	2.2.1 Upgrade combustion plants, adopt low-NO_x technologies, and improve monitoring.	High emissions, mitigation insufficient, multiple sectors and compartments. High investment costs, technological limits, delayed compliance, uneven enforcement across plants and sectors.	Industrial Emissions Directive (2010/75/EU)
3. Protect and restore ecosystems from nutrient-driven degradation	All	3.1 By 2030, nutrient runoff into freshwater and coastal systems has been reduced.	3.1.1 Buffer strips, cover crops, constructed wetlands, catchment-level monitoring	Complexity of nutrient cycles and diffuse emissions, multiple sectors and compartments. Diffuse nutrient sources, farmer adoption of measures, climate impacts, intensive monitoring	Water Framework Directive (2000/60/EC)
		3.2 By 2030, harmful algal blooms and hypoxic zones in	3.2.1 Targeted mitigation in high-risk catchments, monitor water quality, adaptive management	Complexity of nutrient cycles and diffuse emissions, multiple sectors and compartments.	EU Water Policy / national programmes

Objective	Relevant Nutrients/ Nitrogen Forms	Target	Action	Challenge Addressed	Policy Reference / Notes
		high-risk water bodies have been minimised.		Climate-driven factors, early warning limitations, complex ecological responses, multiple sources.	
	All	3.3 By 2040, ecological integrity and ecosystem services in freshwater and coastal habitats are maintained.	3.3.1 Restore riparian zones, maintain natural water flows, rehabilitate impacted habitats.	Complexity of nutrient cycles and diffuse emissions, multiple sectors and compartments. Cumulative pressures, climate change effects, slow ecological recovery.	EU Biodiversity Strategy 2030 (COM/2020/380), Habitats Directive (92/43/EEC)
		3.4: By 2030, at least 30% of EU land and sea areas are protected and restored, including 25,000 km of rivers.	3.4.1: Restore habitats, enforce protected area regulations, enhance resilience.	Multiple sectors and compartments. Ecosystem degradation from nutrient deposition, long timelines, intensive monitoring and enforcement, climate impacts.	EU Biodiversity Strategy 2030 (COM/2020/380)
4. Close the nutrient loop through circular economy and innovation	All, organic waste	4.1 By 2030, recycling of organic waste and by-products has been increased.	4.1.1 Develop composting infrastructure, implement nutrient recovery technologies, establish regional reuse schemes	Complexity of nutrient cycles and diffuse emissions, multiple sectors and compartments. Diffuse nutrient sources; system-level coordination; incentives for circularity; technology gaps.	Farm to Fork Strategy (COM/2020/381), Circular Economy Action Plan (COM/2020/98 final)
	All	4.2 By 2030, integrated nutrient and resource management plans have	4.2.1 Support knowledge transfer, demonstration sites, cross-sector coordination.	Complexity of nutrient cycles and diffuse emissions, multiple sectors and compartments.	CAP Strategic Plans, national initiatives

Objective	Relevant Nutrients/ Nitrogen Forms	Target	Action	Challenge Addressed	Policy Reference / Notes
		been implemented at landscape or regional scale.		Multiple sectors and environmental compartments; difficult to manage, balancing local priorities with regional goals.	
	All	4.3 By 2030, innovative technologies and practices to optimise nutrient flows and enhance system resilience are being promoted.	4.3.1 Precision mapping, digital tracking of nutrient flows, adoption of circular economy solutions.	Complexity of nutrient cycles and diffuse emissions, multiple sectors and compartments. Complex nutrient cycles; long-term system resilience; technological readiness and scalability, high costs.	Horizon Europe, EU Innovation Programmes
5. Reform the Common Agricultural Policy to reward nutrient performance	All	5.1 By 2030, at least 60% of CAP direct payments are conditional on verifiable environmental performance, including nutrient management requirements.	5.1.1 Make subsidies conditional, linking direct payments to farming practices e.g., precision fertilization: mandating soil testing and calibrated application of fertilizers to match crop needs; cover cropping: paying farmers to plant cover crops in the off-season to capture residual nitrogen; and maintenance of buffer strips: providing subsidies for establishing and maintaining vegetated strips along watercourses.	Nutrient flows are complex and diffuse, multiple sectors contribute. Administrative burden and costs, equity (large vs small farms), monitoring to evaluate measures.	CAP post-2027, Zero Pollution Parliament
			5.1.2 Develop an "eco-scheme" by legislating that a 30% of the CAP budget is reserved exclusively for agri-environment-climate commitments, preventing its reallocation to basic income support.	Coordinating across sectors and environmental compartments is challenging. Preventing budget diversion, fair access, administrative complexity.	

Objective	Relevant Nutrients/ Nitrogen Forms	Target	Action	Challenge Addressed	Policy Reference / Notes
			5.1.3 Limit large payments by introducing a progressive capping mechanism for direct payments to very large farms, reallocating those funds to support smaller farms and those undergoing complex transitions to agroecology.	Coordination across sectors and farms is difficult. Fair and effective capping rules, prevention of loopholes, administrative complexity.	
		5.2 By 2035, the EU should achieve a 30% reduction in surplus nitrogen across agricultural soils in Nitrate Vulnerable Zones compared to a 2025 baseline, directly attributable to CAP incentives.	5.2.1 Integration with Other Policies: Ensure CAP strategic plans are legally required to demonstrate alignment with Water Framework Directive and Marine Strategy Framework Directive targets.	Complex cycles and diffuse emissions, multiple sectors and environmental compartments. Farmer compliance, policy coherence, regional variability.	Zero Pollution Parliament
6: Empower consumers and de-risk the transition for farmers	All	6.1 By 2030, establish a mandatory EU-wide nutrient footprint labelling system for major food products that reflects the nutrient footprint.	6.1.1 By 2028, develop a standardised lifecycle assessment methodology to calculate a "fertiliser input per kilogram of product" score (A to G rating).	Complex nutrient cycles, coordination across multiple supply chains is challenging. Methodological consistency, data availability, specific training.	Zero Pollution Parliament
			6.1.2 By 2030, launch a mandatory EU-wide "Nutrient Efficiency Label" for all major staple crops (e.g., cereals, potatoes, vegetables) sold in supermarkets by assigning an A-to-G rating on product packaging.	Multiple sectors involved, complicating standardisation. Ensuring compliance, consumer understanding, administrative and monitoring costs.	

Objective	Relevant Nutrients/ Nitrogen Forms	Target	Action	Challenge Addressed	Policy Reference / Notes
	All	6.2 By 2030, establish a publicly funded "Transition Advisory Service" in every EU MS, aiming to engage at least 25% of all agricultural holders in nutrient reduction planning by 2035.	6.2.1 Establish national transition networks by funding a network of regional advisors, employed by the government but working closely with farming unions, to provide free, one-on-one consultancy on agroecological transition.	Coordinating support across multiple sectors, farms and environmental compartments is challenging. Training of qualified advisors, regional coordination, farmer engagement.	Zero Pollution Parliament
			6.2.2 Support business case development by creating and disseminating region-specific, crop-specific business models that clearly outline the costs, benefits, and market opportunities for low-nutrient farming systems.	Coordinating support across multiple sectors and farms is challenging. Data accuracy and data availability, farmer uptake and trust, practical feasibility of business models.	
			6.2.3 Offer financial support through temporary, targeted income support or low-interest loans to farmers during the transition period, which often involves a temporary dip in yield or profitability.	Coordinating support across multiple sectors and farms is challenging. Fair financial support, preventing misuse, aligning with CAP budget.	

Table 3: Hazardous substances objectives, targets and actions

Objective	Relevant Pollutant Type/ Contaminant	Target	Action	Challenge Addressed	Policy Reference / Notes
1. Harmonise monitoring of most harmful substances.	Most harmful substances	1.1 By 2035 establish a working method that incorporates sampling and analysis methodologies, as well as data exchange mechanisms between river and marine environmental monitoring programmes.	1.1.1 Establish regular meetings between riverine and marine monitoring programmes to exchange knowledge and data on monitoring practices.	Inconsistent monitoring hinders comprehensive assessments and limits the development of effective mitigation strategies.	Marine Strategy Framework (Directive 2008/56/EC), Water Framework Directive and 2026 amendment (2000/60/EC)
			1.1.2 Establish a consultation platform for authorities related to riverine and marine monitoring programmes.		
			1.1.3 Harmonise reporting standards so that datasets from riverine and marine monitoring programmes are interoperable.		
		1.2 Create a coordinated approach (e.g. digital tools) to ensure data on hazardous substances, is Findable, Accessible, Interoperable, and Reusable (FAIR), starting in data rich areas.	1.2.1 Develop a platform (e.g. data repository, digital tools) with data from curated datasets, based on harmonised sampling and analysis methodologies to improve the quality of predictions (such as hotspot areas, concentration differences between environmental matrices, and concentration distributions over time).	Data and understanding gaps make it difficult to establish causal links between concentrations and environmental harm.	Marine Strategy Framework Directive 2008/56/EC, Drinking Water Directive 2020/2184, Regulation (EU) 2025/2455
			1.2.2 Create models to predict where monitoring should happen exploring the use of big data approaches.		
		1.3 Support the performance of robust risk assessments of chemicals/substances by	1.3.1 Find out what data is most often missing to perform a robust risk assessment for chemicals/substances and ensure that monitoring programmes will provide that		Zero Pollution Parliament

Objective	Relevant Pollutant Type/ Contaminant	Target	Action	Challenge Addressed	Policy Reference / Notes
		identifying and filling data gaps.	data, for example following the plan-do-check-act (PDCA) cycle.		
2. Improve transparency throughout the value chain	All hazardous substances	2.1 Facilitate implementation of Safe and Sustainable-by-Design (SSbD) principles by ensuring that confidential information that is required for execution of SSbD processes can be shared throughout the value chain.	2.1.1 Building onto the existing REACH-IT portal, the EU creates a secure space where confidential data can be shared and accessed by those companies that develop specific chemicals/substances/materials that are responsible for emissions throughout their value chain.	Lack of SSbD implementation	REACH Regulation ((EC) 1907/2006), Methodological guidance to SSbD, European Chemicals Industry Action Plan (COM(2025)530)
			2.1.2 Set clear guidelines on how companies should use the tools in the SSbD framework but allow for adapting the guidelines based on the learning and experience from early adopters; start small and use an iterative approach.	Lack of incentive for industry to implement SSbD principles	
			2.1.3 Use public procurement processes to stimulate SSbD implementation, especially in tender processes.	Lack of SSbD implementation	
			2.1.4 Create a level playing field among companies within the EU to ensure that companies that invest significantly in developing safe and sustainable products will be able to capitalise on these efforts. Companies from outside of the EU, must also meet the same requirements for products imported and sold within the EU.	Lack of incentive for industry to implement SSbD principles	

Objective	Relevant Pollutant Type/ Contaminant	Target	Action	Challenge Addressed	Policy Reference / Notes
3. Drive transformative shift towards a sustainable, circular, and climate-neutral EU industry by integrating SSbD principles into large-scale development projects	All hazardous substances	3.1 By 2030, publicly funded large-scale infrastructure and product development projects will demonstrably integrate SSbD principles throughout their lifecycle.	3.1.1 Develop mandatory SSbD criteria within EU funding programmes for large-scale projects, prioritising investments that demonstrably contribute to lower environmental and human health impacts, decarbonisation and resource efficiency.	Lack of incentive for industry to implement SSbD principles	EU Clean Industrial Deal 2025/85, Revised CLP Regulation EU 2024/2865, General Product Safety Regulation 2023/988, Regulation (EU) 2025/2455, Methodological guidance to SSbD
			3.1.2 Implement SSbD in chemical product development trajectories and ensure that the end product is the focal point in the lifecycle analysis (to prevent steering towards the development of low-quality products).	Steering towards the development of low-quality products.	
4. Stimulate innovation of sustainable chemicals, ingredients, processes, and products.	All hazardous substances	4.1 By 2030, the EU establishes a support programme for the development of wastewater treatment plants for emerging industrial practices that are expected to grow in Europe.	4.1.1 Develop technology to concentrate hazardous substances, such as PFAS, to enhance the effectiveness of removal and remediation from large water quantities such as streams in wastewater treatment plants.	Release of PFAS into water bodies	2024 Revised Urban Wastewater Treatment Directive (UWWTD) (EU 2024/3019), Zero Pollution Parliament
			4.1.2 Develop energy efficient methods and nature-based solutions (e.g., constructed wetlands) that adhere to circular economy principles for the removal of hazardous substances from different environmental matrices and waste streams and subsequent end-of-life treatment.		
			4.1.3 Invest in wastewater treatment technology for renewed mining activities to secure the supply of critical resources, which should ideally be done without creating environmental harm in those regions where (deep sea) mining takes place.		

Objective	Relevant Pollutant Type/ Contaminant	Target	Action	Challenge Addressed	Policy Reference / Notes
5. Promote uses of safer alternatives	Most harmful substances	5.1 Phase out the manufacturing, import, and use of most harmful substances, including all PFAS to significantly decrease the input of hazardous substances into the natural environment.	5.1.1 Start with phasing out hazardous substances in non-essential uses.	Input of hazardous substances into the natural environment.	Communication 2024/2894 (Guiding criteria and principles for the essential use concept in EU legislation dealing with chemicals), Zero Pollution Parliament
			5.1.2 Create clear guidelines for judgement of essentiality and verify these by stakeholder consultation.		
			5.1.3 Ensure that future development of active substances used in biocides, plant protection products and medicinal products adheres to SSbD approaches, similar to substances that fall under REACH.		
			5.1.4 Invest public funds into development of SSbD alternative chemicals and materials, both for basic research as well as applied research.		
	All hazardous substances	5.2 Create a shared responsibility by incentivising companies that use, import or manufacture hazardous substances to invest into the development of SSbD alternatives.	5.2.1 Companies invest into the development of SSbD alternatives at their own R&D departments or in collaboration with external parties. A system where companies that are successful in finding an alternative should profit the most in the longer term (e.g., via societal incentives to switch to the new chemicals and materials).	Lack of incentive of industry to develop alternatives.	Zero Pollution Parliament
			5.2.2 Part of the investment goes into an insurance mechanism that compensates those companies that invested into technologies that turn out to be less successful. This could be a proactive		

Objective	Relevant Pollutant Type/ Contaminant	Target	Action	Challenge Addressed	Policy Reference / Notes
			implementation of the polluter-pays principle.		
	PFAS	5.3 18 months after entry into force of the PFAS restriction proposal, companies that make use of a derogation for PFAS use for a specific application, need to invest a specific percentage of their revenue to develop alternatives.	5.3.1 Following the reporting approach included in the PFAS restriction proposal on the continued use of PFAS under a specific derogation, the EU integrates reporting obligations on the progress companies make towards developing alternatives.	Lack of incentive of industry to develop alternatives.	PFAS restriction proposal under REACH
6. Raise public awareness on levels of hazardous substances	PBCs, metals	6.1 By 2030, for areas in which monitoring is in place, a dashboard should be made available by Member States (e.g., PCBs, metals).	6.1.1 Create a dashboard aggregated value that reflects concentration levels in a certain area of hazardous substances and values that show how harmful certain chemicals are.	Limited awareness of non-experts on levels of chemical pollutants.	Zero Pollution Parliament, EEA zero pollution dashboard
	All hazardous substances		6.1.2 Once monitoring operations for certain substances are in place, the dashboard should be expanded to reflect these additions.		

Table 4: Microplastics objectives, targets and actions

Objective	Relevant Pollutant Type / Contaminant	Target	Action	Challenge Addressed	Policy Reference / Notes
1. Minimise microplastic release from tyre and road wear into water bodies	TWPs, TRWPs	1.1 By year 2036, each Member State has implemented civil engineering solutions retaining or reducing the spread of tyre wear particles in at least 50% of its designated urban areas, prioritising regions with high traffic density and runoff impact.	1.1.1 Expand Road runoff collection, optimise treatment systems, and deploy mechanical road cleaning in urban areas prone to high vehicular activity.	Tyre wear particles washed into waterways due to insufficient runoff collection.	Zero Pollution Action Plan (COM/2021/400), Euro 7 Regulation (EU 2024/1257), Sustainable Urban Mobility Plans, UWWTD (EU 2024/3019)
			1.1.2 Promote the development of particle retention systems at or near roadways – such as permeable pavements, sedimentation basins, roadside vegetation, constructed wetlands – to limit the transport of tyre wear particles via surface water runoff.	Lack of local retention allows transport of tyre wear particles to water bodies.	
			1.1.3 Upgrade urban wastewater treatment plants to enhance the capture and treatment of tyre wear particles before they reach natural water bodies.	WWTPs cannot efficiently remove fine tyre wear particles.	
			1.1.4 Promote low-abrasion road surface materials and maintenance practices to reduce tyre wear particle generation.	Increased tyre wear particle emissions due to road construction and use of materials.	
		1.2 By 2036, at least 40% of new vehicles and tyres placed on the EU market comply with enhanced eco-design standards aimed at reducing tire wear particle emissions and improving	1.2.1 Promote the design and mandatory labelling of low-abrasion tyres through EU eco-design requirements (including under the ESPR) and relevant product and vehicle legislation, including the Tyre Labelling Regulation and Euro 7 requirements where applicable.	Absence of eco-design standards limits adoption of low-emission tyres.	Ecodesign for Sustainable Products Regulation (ESPR) 2024/1781, Tyre Labelling Regulation (EU 2020/740), Euro 7

Objective	Relevant Pollutant Type / Contaminant	Target	Action	Challenge Addressed	Policy Reference / Notes
		overall environmental performance.	1.2.2 Establish EU-wide performance criteria for tyre abrasion and rolling resistance, building on Euro 7 requirements and integrating them into vehicle eco-design requirements under the ESPR and vehicle type-approval frameworks to ensure consistency, enforcement, and continuous improvement in tyre environmental performance.	No harmonised criteria and standards for tyre wear reduce emission control.	Regulation (EU 2024/1257)
			1.2.3 Support the development, testing, and adoption of on-vehicle tyre wear particle capture technologies through EU research and innovation programmes.	Limited deployment of capture tech slows microplastic reduction.	
		1.3 By 2030, Member States implement comprehensive policies promoting sustainable driving behaviour and reducing private car dependency in urban areas by at least 20% to lower tyre wear emissions and overall environmental impacts from road transport.	1.3.1 Develop and expand urban mobility policies that encourage modal shifts, such as improving public transit accessibility, investing in safe cycling and walking infrastructure, and establishing low-emission zones and expanding rail infrastructure to reduce reliance on private car use in urban centres.	High private car use increases tyre wear emissions.	Sustainable and Smart Mobility Strategy (COM/2020/789 final)
			1.3.2 Mandate the inclusion of eco-driving modules in all new driver training and licensing programmes, complemented by public campaigns to low tyre-wear driving habits.	Lack of driver awareness leads to avoidable tyre wear.	
2. Reduce microplastic emissions from synthetic textile fibres through	Synthetic textile fibres	2.1 Reduce the release of microplastics from textile washing processes by at least 50% by 2036.	2.1.1 Introduce mandatory standards requiring all new washing and drying machines sold in the EU from 2030 onwards to be equipped with certified microplastic filtration systems that effectively capture synthetic fibres during washing and drying, as	Washing machines release synthetic fibres due to no filtration requirement.	Plastics Strategy (COM/(2018/) 28 final)

Objective	Relevant Pollutant Type / Contaminant	Target	Action	Challenge Addressed	Policy Reference / Notes
upstream prevention			well as clear consumer guidance on how to use them.		
			2.1.2 Support research and development into low-shedding fibres and textile products, recognising that fibre shedding varies significantly depending on fibre type (e.g. natural, synthetic, and blended fibres), yarn construction, fabric structure, and manufacturing and finishing processes. A more detailed understanding of these parameters is necessary to effectively reduce fibre release across different textile categories.	Fibres and textiles are not designed to minimise shedding.	
			2.1.3 Implement consumer awareness campaigns on reducing environmental fibre release through washing frequency, laundering practices and garment choice, while recognising that further data is needed to strengthen the evidence base for specific recommendations on garment selection.	Consumers unaware of practices to reduce fibre release.	
3. Prevent unintentional plastic pellet losses across the entire plastics supply chain	Plastic pellets	3.1 By 2030, achieve at least a 30% reduction of plastic pellet losses across the entire plastics supply chain in the EU.	3.1.1 Mandate binding EU-wide regulations requiring all plastic producers, converters, and transporters to implement standardised containment and spill prevention measures, including secure storage, handling protocols, incident reporting, and preventative measures such as container air bags and optimised transport methods (e.g., local production, limiting transport via waterways), in alignment with relevant international	Poor handling and enforcement cause pellet losses.	

Objective	Relevant Pollutant Type / Contaminant	Target	Action	Challenge Addressed	Policy Reference / Notes
			frameworks including ongoing work under the IMO for maritime transport.		
			3.1.2 Develop pellet fingerprinting and traceability systems to differentiate operational versus transport-related losses, assign accountability, and support enforcement across the supply chain.	Lack of traceability prevents accountability in pellet loss	
4. Enhance microplastic capture and removal in urban wastewater and stormwater systems	All microplastics	4.1 By 2030, at least 50% of municipalities within each Member State have implemented wastewater and stormwater treatment solutions to effectively capture and remove microplastics before they enter waterways.	4.1.1 Expand and optimise stormwater collection and treatment systems in urban areas to reduce microplastic loads entering wastewater and surface water pathways.	Diffuse microplastic sources and their impacts on water quality. Conventional treatment does not remove microplastics effectively. Sludge application reintroduces microplastics without limits. No harmonised monitoring hinders policy assessment.	Plastics Strategy (COM/(2018/) 28 final), 2024 Revised Urban Wastewater Treatment Directive (UWWTD) (EU 2024/3019)
			4.1.2 Upgrade urban wastewater treatment plants and incorporate nature-based solutions, including constructed wetlands to enhance microplastics capture before they reach natural water bodies.		
			4.1.3 Establish limits for microplastics in sewage sludge applied to agricultural land.		
			4.1.4 Introduce mandatory monitoring and reporting of microplastic removal efficiency in WWTPs, including microplastic concentrations in influent, effluent, and sludge, to enable assessment of treatment performance and residual emissions.		
5. Reduce microplastic emissions from paints,	Microplastics f rom paints, coatings, and	5.1 By 2040, all industrial surfaces and coatings in the EU adopt sustainable materials and technologies	5.1.1 Promote the development of durable, sustainable coatings with minimal degradation.	Rapid degradation releases microplastics during use.	Zero Pollution Action Plan (COM/2021/400), Chemical Strategy for

Objective	Relevant Pollutant Type / Contaminant	Target	Action	Challenge Addressed	Policy Reference / Notes
coatings, and industrial surfaces	industrial surfaces.	that minimise microplastic release during use and degradation.	5.1.2 Explore alternative surfacing technologies for cars, ships, new builds, and industrial applications.	Reliance on polymer coatings sustains microplastic emissions.	Sustainability (COM/2020 /667 final)
			5.1.3 Implement coatings and industrial materials with controlled/ programmed biodegradability, applied only where appropriate, ensuring that valuable components are recovered prior to degradation and that biodegradation occurs under controlled conditions at end-of-life to minimise microplastic release.		
6. Reduce microplastic emissions from fertilisers and soil	Microplastics from fertilisers and soil	6.1 By 2030, minimise microplastic contamination in agricultural soils and fertilisers through the adoption of sustainable practices, monitoring, and mitigation measures.	6.1.1 Identify and assess all sources of microplastics in fertilisers and agricultural soils, including unintentional releases, to inform targeted mitigation measures and support compliance with REACH microplastic restrictions.	Poor knowledge of microplastic sources hinders mitigation.	Farm to Fork Strategy (COM/2020/381), Chemicals Strategy for Sustainability (COM/2020 /667 final), Fertilizer Regulation 2019/1009
			6.1.2 Align mitigation strategies with climate-smart agricultural practices and soil management systems to ensure microplastic reduction is integrated with sustainable crop and soil management.	Microplastic measures not integrated with soil/climate practices.	

Table 5: Underwater noise objectives, targets and actions

Objective	Relevant Pollutant Type	Target	Action	Challenge Addressed	Policy Reference / Notes
1. Reduce underwater noise from shipping and other vessels	UWN from ships and other vessels	1.1 By 2030, a 2 dB underwater noise reduction is achieved (with consideration of a more ambitious 3 dB reduction).	1.1.1 Establish quiet zones by 2026 through MSP in ecologically sensitive areas, supported by sound maps and species distribution data, and implemented via routing measures, speed limits, or access restrictions for noisier vessels.	Habitat degradation, biodiversity loss (masking of communication, behavioural changes, etc.).	Marine Strategy Framework Directive 2008/56 (Descriptor 11), Maritime Spatial Planning Directive 2014/89, Zero Pollution Action Plan (COM/2021/400), IMO guidance on speed reduction and co-benefits for GHG mitigation, IMO Guidelines for the Reduction of Underwater Radiated Noise from Shipping, ship design standards integrating URN alongside energy efficiency
			1.1.2 Slow down shipping through implementation of speed reduction schemes on a voluntary basis in priority areas, supported by port incentives and digital traffic management tools, and aligned with greenhouse gas mitigation objectives.	Environmental impacts, carbon emissions.	
			1.1.3 Improve ship design by promoting the adoption of low-noise propellers, hull forms, and vibration isolation technologies in new builds and retrofits, including through incentives, funding mechanisms, and support for research into cost-effective engineering solutions, while leveraging synergies with energy-efficiency and decarbonisation requirements.	Cavitation, machinery noise, air bubble noise, hull-generated noise.	
		1.2 By 2050, a 6 dB underwater noise total reduction is achieved.	1.2.1 Integrate noise considerations into ship design processes starting 2030–2035. Embed underwater noise performance as a design parameter alongside emissions and safety in EU and IMO standards, classification rules, and procurement requirements.	Cavitation, machinery noise, air bubble noise, hull-generated noise.	Marine Strategy Framework Directive 2008/56, IMO Guidelines, long-term fleet renewal strategies, classification society rules
		1.3 By 2027, a harmonised European underwater noise index to guide port policies	1.3.1 By 2029 30% of EU ports, which includes the national primary ports in EU countries, adopt a noise ship index in line with IMO recommendations within their environmental	Lack of standardisation and benchmarking of noise emission performance of ships and ports.	Marine Strategy Framework Directive 2008/56, port incentives and green port

Objective	Relevant Pollutant Type	Target	Action	Challenge Addressed	Policy Reference / Notes
		and ship incentives is being developed.	programmes, referring to scientific outputs (e.g., SATURN project).		strategies, Zero Pollution Parliament
			1.3.2 By 2040, the noise ship index is expanded to 60% of EU ports adopting the index for progressive harmonisation across Member States, supported by the European Maritime Safety Agency (EMSA) and regional cooperation	Inconsistent application.	
			1.3.3 By 2050 100% of EU ports have adopted the index, supporting consistent application of URN benchmarks and environmental labelling. The index should be linked to port fee differentiation, priority berthing, and environmental labelling schemes.	Inconsistent application	
2. Establish consistent underwater noise monitoring and reporting infrastructure	All UWN	2.1 By 2035, establish a functional, interoperable underwater noise monitoring and reporting network covering key maritime areas, which could, where appropriate, adopt a risk-based prioritisation approach focusing on busier and higher-pressure sea areas, in alignment with MSFD provisions, contributing to a measurable reduction in	2.1.1 Establish monitoring stations in high-traffic areas with shared cost models (public and private). Priority should be given to ports, shipping corridors, offshore energy zones, and marine protected areas.	Understanding noise levels and tracking changes over time. Lack of comprehensive, long-term underwater noise monitoring.	Marine Strategy Framework Directive 2008/56 (Descriptor 11), Regional Sea Conventions (e.g., OSPAR, HELCOM Impulsive Noise Registers), sound mapping initiatives (e.g., JOMOPANS), ISO Standards (ISO 7605 and ISO 17208-3, ISO 23990)
			2.1.2 By 2035: 30% of vessels (including fishing vessels) are baselined for noise emissions. Baselining should follow harmonised protocols aligned with ISO 7605 and ISO 17208-3.	Understanding noise sources.	
			2.1.3 Gaps in military and non-commercial vessel data are addressed, following MSFD reporting obligations; confidential or aggregated reporting approaches, as well as NATO and national mitigation frameworks.	Data gaps.	

Objective	Relevant Pollutant Type	Target	Action	Challenge Addressed	Policy Reference / Notes
		noise pollution impact on marine ecosystems.	2.1.4 Reliable data upload, harmonised standards, and improved communication between stations is ensured. Harmonisation is supported through ISO standards (ISO 7605, ISO 17208-3, ISO 23990) and EU Harmonise project.	Inconsistency of data, methods and standards.	
			2.1.5 Underwater noise reporting is embedded into environmental performance metrics across the maritime sector. Integration into Environmental, Social, and Governance (ESG) reporting considering impacts on the environment (E), such as emissions, pollution, resource use, biodiversity impacts (including underwater noise in a maritime context), impacts on people and communities, including worker safety, human rights, community impacts, and stakeholder engagement (S), and how an organisation is managed and governed, including transparency, accountability, risk management, and compliance reporting, port environmental programmes, and sustainability indicators (G).	Lack of incentives for industry to reduce noise emissions.	
3. Develop an integrated approach to strengthen public awareness, enable informed choices, and clearly	All UWN	3.1 Integrate underwater noise awareness into maritime training and ship design.	3.1.1 Early awareness campaigns, mandatory training modules, and educational content (e.g., documentaries) as part of career development in maritime sectors as well as ship design.	Limited awareness of impacts of noise on marine life.	Zero Pollution Action Plan (COM/2021/400), EU environmental labelling initiatives
			3.1.2 Technical training for engineers and maritime personnel is integrated into qualifications for maritime sectors and boating licences. Training should address both continuous and impulsive noise sources,	Low priority or unawareness of operational practices on noise levels.	

Objective	Relevant Pollutant Type	Target	Action	Challenge Addressed	Policy Reference / Notes
communicate the sector's commitment to greener, quieter passenger and goods transport			mitigation technologies, and regulatory requirements.		
		3.2 Enhance consumer engagement through transparent information on the environmental performance of maritime transport, presented as part of a combined, comprehensive environmental labelling approach.	3.2.1 Explore opportunities to communicate the environmental performance of maritime transport to consumers through digital information tools or labelling approaches, including information on underwater noise reduction and GHG emissions.	Disconnect between scientific understanding and practical application in the maritime industry.	
			3.2.2 Cruise ships, passenger vessels, and ferries provide on-board displays or short videos showcasing their efforts to reduce Underwater Radiated Noise alongside other green measures, creating a single, unified message on environmentally friendly maritime transport.	Limited awareness of industry contributions to address underwater noise.	
4. Reduce and manage impulsive underwater noise	Impulsive UWN	4.1 By 2030, impulsive noise events are systematically recorded, assessed, and mitigated across EU marine regions.	4.1.1 Establish and harmonise impulsive noise registers across regional seas, drawing on existing examples, e.g., OSPAR impulsive noise register.	Acute disturbance, injury, and displacement of marine species	Marine Strategy Framework Directive 2008/56 (Descriptor 11C1), OSPAR/HELCOM Impulsive Noise Registers, QUIETMED/QUIETSEAS, ACCOBAMS and ASCOBANS guidance, precautionary principle, Maritime Spatial Planning Directive 2014/89, EIA/SEA requirements
			4.1.2 Promote alternatives to high-intensity impulsive sources (e.g. vibroseis, low-order deflagration, non-impact foundations). SONIC, AQUO, UXO deflagration research investigates methods for neutralising explosives using controlled, low-order reactions that release energy gradually, rather than through a high-order detonation, thereby significantly	High-intensity impulsive noise from construction UXO, seismic surveys.	

Objective	Relevant Pollutant Type	Target	Action	Challenge Addressed	Policy Reference / Notes
			reducing peak sound pressure levels and environmental impacts.		
			4.1.3 Apply spatial and seasonal restrictions in sensitive habitats through MSP, building on coordination mechanisms such as the Greater North Sea Basin Initiative (GNSBI), which can support alignment and regional coherence of national Marine Spatial Plans across Member States while respecting their individual planning competencies, and providing a framework to better account for the transboundary nature of underwater noise propagation and cumulative impacts.	Exposure of sensitive habitats.	
5. Integrate underwater noise into Marine Spatial Planning	All UWN	5.1 By 2030, underwater noise considerations are systematically integrated into MSP processes.	5.1.1 Use sound maps and cumulative effects assessments to inform spatial allocation of activities.	Fragmented spatial management.	MSP Directive 2014/89, Marine Strategy Framework Directive 2008/56 programmes of measures, cumulative effects assessment frameworks, EU Nature Directives, EIA and SEA Directives
			5.1.2 Identify and protect low-noise refuge areas and ecologically sensitive soundscapes.	Loss of acoustic habitat quality.	
			5.1.3 Align MSP measures with MSFD programmes of measures and EIAs for cross-sectoral planning coherence.	Poor coordination between planning and licensing.	
6. Establish harmonised	All UWN	6.1 By 2028, harmonised terminology, metrics, and	6.1.1 Support adoption of ISO 23990, ISO 7605, and ISO 17208-3.	Lack of comparability across assessments.	ISO 23990 (bioacoustics terminology), ISO 7605

Objective	Relevant Pollutant Type	Target	Action	Challenge Addressed	Policy Reference / Notes
standards, definitions, and assessment frameworks		observation windows are adopted across EU underwater noise assessments	6.1.2 Harmonise definitions for LOBE, Temporal Observation Windows (TOW), and Spatial Observation Windows (SOW) aligned with TG Noise recommendations and scientific terminology work (e.g. SATURN project).	Inconsistent interpretation of impacts.	(ambient noise), ISO 17208-3 (vessel URN), TG Noise recommendations, scientific outputs), Marine Strategy Framework Directive 2008/56 implementation guidance
			6.1.3 Develop EU guidance for verification and validation of sound maps, aligned with scientific work (e.g. NAVISON, JOMOPANS, SATURN Projects).	Uncertainty in modelling outputs.	

Table 6: Actions across the four pollutants

Objective	Relevant Pollutant Type	Target	Action	Challenge Addressed	Policy Reference / Notes
1. Foster a community of practice and ensure cooperation and coordination across relevant stakeholder and expert groups	All	Target 1.1: By 2030, establish a community of practice within the EU considering source-to-sea pollutant pathways and including diverse stakeholders and perspectives such as human health (Zero Pollution Parliament).	Action 1.1.1: Create multi-expert working groups (for specific pollutants) with experts from Member States as well as EU and regional sea bodies and spanning different types of knowledge (e.g., including human health) to foster exchange and dialogue on existing challenges and best practices, as well as address specific issues considering identified pollutant pathways.	Knowledge as scientific advice for policy; Stakeholder inclusive policy design and implementation.	Zero Pollution Parliament
			Action 1.1.2: Establish an EU-wide multi-stakeholder platform for pollutants including diverse stakeholders (e.g., health and environment) from across the source–to-sea approach in an effort to align regional and		

Objective	Relevant Pollutant Type	Target	Action	Challenge Addressed	Policy Reference / Notes
			national priorities and actions through enhanced cooperation and exchange.		
2. Increase transparency and knowledge of pollutants on environmental risks, source emissions and transport pathways into the marine environment to raise awareness	All	Target 2.1: By 2030, raise awareness and boost knowledge among citizens about the potential exposure risks to pollutants (Zero Pollution Parliament).	Action 2.2.1: Create a public facing poly-pollutant risk information platform to provide citizens access to knowledge and information concerning potential risks, including on human health, from pollutants in the marine environment.	Stakeholder inclusive policy design and implementation.	Zero Pollution Parliament
3. Improve monitoring and evaluation of progress towards policy objectives and underpin enforcement	All	Target 3.1: By 2030, establish an EU mechanism to measure progress towards EU policy targets as part of the future EU Ocean Dashboard under the Ocean Act (Zero Pollution Parliament).	Action 3.1.1: Expand upon the European Environment Agency's (EEA) Zero Pollution Dashboards and Monitoring tool and develop an online EU pollution policy tracking tool taking into account the source-to-sea approach and including e.g. policy updates and revisions, changes in industry standards, ongoing reporting deadlines and requirements, and compliance challenges. Action 3.1.2: Address key gaps in knowledge as outlined in the EEA's Pollution Monitoring and Outlook 2025 such as clear and precise definitions of pollutants and targets, understanding about potential risks to human health, transboundary pollutants and cumulative impacts caused by the synergistic effects of multiple pollutants in the marine environment.	Policy evaluation and adaptive management.	Zero Pollution Parliament

Objective	Relevant Pollutant Type	Target	Action	Challenge Addressed	Policy Reference / Notes
			Action 3.1.3: Establish an EU pollution task force, including representatives from e.g. government, industry, research, civil society and certification bodies, to assess progress towards EU pollution policy targets and advise the Ocean Board on policy effectiveness, identified challenges and gaps.		
4. Strengthen regulatory frameworks and promote best practices to prevent pollution within the EU and beyond	All	Target 4.1: Strengthen the existing regulatory and governance framework addressing pollution in the EU including at the regional and international level (Zero Pollution Parliament).	Action 4.1.1: Create EU-wide guidelines and best practices for addressing pollution and implementing existing EU policies through the source-to-sea approach.	Clear scope and targets.	Zero Pollution Parliament
			Action 4.1.2: Fund research and innovation projects through EU mechanisms targeting the improvement of policy and governance across the source-to-sea approach focusing on policy design and implementation of existing and established EU and Member State policies.	Clear scope and targets; Knowledge as scientific advice for policy; Policy evaluation and adaptive management.	
			Action 4.1.3: Continue to support the international dimension of global pollution governance, through e.g. leading in global negotiations for a Plastics Treaty and supporting existing global agreements.	External dimension and global cooperation.	

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